QST

december, 1942

25 cents

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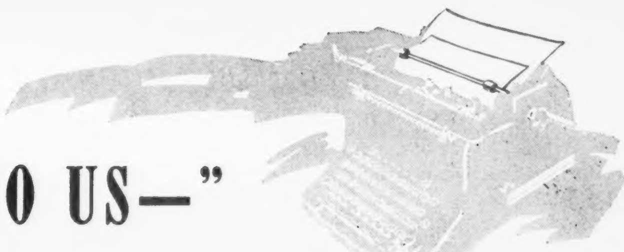
devoted entirely to

amateur radio

U. S. NAVY OFFICIAL PHOTO

"IT SEEMS TO US—"



YOUR COUNTRY NEEDS YOU

As the first anniversary of our participation in the war approaches, it is sinking in on Americans that this is to be a harder and more desperate struggle for survival than we had expected. The needs grow greater all the time.

Radio is playing a phenomenal part in this war. Every plane, vessel, tank and command post must have radio communication. Then there are radar, intercept, d.f. and what-not. All this apparatus must be maintained as well as operated. Net result is that hundreds of thousands of trained operators and technicians are needed.

Where do you think hundreds of thousands of trained operators and technicians are coming from? They are being *made*, at schools, from completely raw material. Who is going to teach them? Thousands of trained or semi-trained instructors, not themselves eligible to fight, are needed to do *that* job.

You Class III-A amateurs, you IV-Fs, and particularly you YLs: your country needs you—*now!* Not necessarily in uniform; civilians can serve just as fully and just as well, in many cases more successfully. There is a critical need for instructors — of theory and shop work particularly. If we don't succeed in training those new people to be effective operators and mechanics, and turn them out by the tens of thousands, the whole business of the war will bog down, and that means eventual slavery. Everyone with a specialized knowledge of radio, or the inherent ability to acquire it in a reasonable period of time, is needed to jump in and help. Numerous calls for instructors have been published in *QST*, more in this issue. The situation is bad, it is growing worse, it will be at a crisis this winter. If you've an amateur license you know more about radio than some of the present instructors and you have the kind of mind that can rapidly learn what else you need to know.

Can't you tear yourself away from that kitchen, that filling station, and get into a school? Not only will you get an education yourself that will be invaluable but you can fill a grim gap in the military machine. If you can't fight, teach!

W.E.R.S. NEEDS YOU TOO

The season of long winter nights is at hand. Can any of us be confident that his community will experience neither an enemy visitation nor some equally ruthless act of nature? Our ability to cope with the communications problems attendent upon such events depends upon the skill with which we build up WERS organizations in our home communities. Any such event will precipitate a first-class communications emergency. The telephone systems will not stand up; indeed, they get loaded to the breakdown point even in practice alerts, despite the educational effort against unnecessary calls. And it has been the experience of England that the wires are lost in every bombardment of any consequence. Then the English ARP services have only runners, foot messengers; they haven't the operators and apparatus to organize a radio service.

In this country our communities have the right to qualify for WERS licenses. In hundreds of our cities the work of organizing and preparing the auxiliary radio communications system for civilian defense is well advanced. A recent change in licensing policy, reported in our Operating News this month, will accelerate licensing these cities. Now ask yourself who is going to man and equip these systems under these wartime conditions. There's only one answer: the brunt of the job falls on civilian amateurs who are still at home. Every love of home, every sense of duty, must impel us to step forward and offer our u.h.f. gear and our services as operators. Moreover, we'll have to help train more men and women of the community for operator certificates, help build more equipment for the needed points of communication.

It is up to us amateurs to do this job and do it successfully. If you're not yet participating, read up on the subject in your back copies of *QST*, particularly the July number, and get in touch with your local Emergency Coördinator or civilian-defense officials to see what you can do to help. Much more help is needed everywhere and the critical season of the year is upon us.

K. B. W.

★ SPLATTER ★

OUR COVER

Yes, these *are* your meters — received from hams in response to the urgent plea from the Signal Corps (p. 43, November *QST*). And those shown are but a few; several hundred were received in the first few days alone following the appearance of that issue. They are already marching off to war with Democracy's Victory army.

But this is only the vanguard among the regiments of instruments required to fill the crucial need. Many more of our milliammeters must march to help turn the tide. Make sure yours are in the front ranks!

The call is out — let all patriotic meters and their owners now stand up and be counted.

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FOOTNOTES

The City of Akron, Ohio, seems to dominate our list of non-staff contributors to this issue — but that condition is justified by the job the hams there are doing. County Radio Aide **Rex Brown, W8LUT,** and his assistant, **D. L. Moody** (p. 11), with the coöperation of a loyal and active crew, are setting a swift pace in WERS progress. W8LUT, who up to December 7th was one of those fellows you seemed to hear on the air every time you tuned in, is a construction engineer with B. F. Goodrich in his spare time (and that cliché comes close to precise truth in this instance, now that WERS has come along). Ass't Radio Aide Moody, a patent attorney with the same firm, has a long career as an intent sideline looker-on at ham radio. **John Bailey, W8UJB** (p. 41), who describes the stabilized m.o.p.a. which is the basic design for the control-center transmitters in the Akron WERS program, is the fellow who got civilian-defense rolling in that city in the first place. He can take pride in the way the rest of the boys are carrying on. Incidentally, it's Lieutenant John Bailey, now . . . of the Army Air Forces!

We like to think of **Dr. T. A. Gadwa, W2KHM** (p. 17), whenever we look at the tires on our flivver. For W2KHM is by profession a chemical engineer — and his current work is in the synthetic rubber program. Maybe with a ham in there now we *will* get tires! Anyway the chances are good. Dr. Gadwa's hobbies are amateur radio and travel; he has been licensed since 1924 (7JH-7AJF-W3CPO-W1IXK is the roll of personal calls, plus operation at W8YA and W1MX), and has visited every state and a dozen foreign lands. You'll be glad to know there are more instructive articles from Dr. Gadwa's informative pen coming up soon. **C. B. Wolfe, W9LJO** (p. 26), was "making something from nothing" as far back as the early 20s, in high school at Goodland, Kansas. Cashing in a World War I $5 "Baby Bond" to buy a tube, he made his first receiver with a school slate for a panel and a variocoupler wound on a cardboard rug roll. Headphones were old telephone receivers and the "A" battery a junker from a battery shop. It worked! The application for an amateur ticket was filled out but somehow never sent in, and then college shoved radio into the background. Photography was a hobby for a while, until the always-smoldering interest in radio burst into flames again several years ago. Now he's a linotype machinist on the Hastings (Neb.) *Daily Tribune*, winner this year (for the second time) of the national title of "best daily newspaper in cities of less than metropolitan size." **Dawkins Espy, W6UBT** (p. 32), is by way of being a sort of protégé of ours, having (as W5CXH) won the 1939 Hiram Percy Maxim Memorial Award as America's most outstanding young amateur under 21. Since then he has been busily making a name for himself in the radio world, first as a b.c. engineer and announcer and currently in special research projects. A lover of the science of mathematics for its own sake, he is the author of a number of articles on the subject published in the engineering journals.

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As a final footnote, *QST* expresses appreciation to the Signal Corps' Fort Monmouth Public Relations Office for the photographs of U. S. Army field radio equipment on pages 22–25. Some of these pictures were taken especially for us; others have been published elsewhere; all are interesting and informative. Along with radio and wire communications, it is one of the duties of the Signal Corps to take pictures — and they prove by performance that they know that part of the job as well as they know radio.

P.S. Some day we'll show you the *inside* of that gear!

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FEEDBACK

Japs are a damned nuisance — in more ways than one. Our attempted correction for PI in the Japanese code chart (original article p. 24, September, *QST;* corrections p. 112, November) apparently ran afoul the Monotype's patriotic reluctance to talk any such barbaric language correctly — even in code. We can only try again:

PI *should* have been — — · · —
· · — — ·

IF YOU CHANGE YOUR ADDRESS—

Please give us as much advance *direct* notice as is possible — also *be sure* to put both your *new* and your *old* address on the letter or card (not the envelope).

Akron and the WERS

The First City With a WERS License Puts the Plan to Work

BY REX T. BROWN,* W8LUT, AND D. L. MOODY*

THE ORGANIZATION of a communications system for civilian defense of Summit County was, from its inception, based upon a full and coördinated use of four general groups of communication facilities: wire, radio, automotive and pedestrian. Three of these groups were readily available and therefore quickly organized and placed in operation, these groups being the telephones in the wire group, automobiles and motorcycles in the automotive group and Boy Scouts and newspaper boys in the pedestrian group. In the radio group, including commercial radio stations and municipally- and privately-owned short-wave systems available for use within certain limitations, the need for a civilian-defense u.h.f. radio system loomed as a "must."

Although the landline telephone system may be considered, under normal conditions, the primary means of communication, in the event of an air raid or acts of sabotage the telephone system is subject to attack and disruption, thus necessitating transference of the burden of communications work to the other facilities. For this reason, all of the Summit County U. S. Civilian Defense Corps planning, organization and operation in regard to communications has been developed and based upon a full simultaneous use of all of the four groups noted above, rather than giving any one facility the preferential position. Such a plan of operation, well-rehearsed, will in time of emergency facilitate the transfer of communications work automatically as one or more of the available facilities becomes substantially inoperative.

Among the many uses for the WERS system, it is evident that the most urgent messages may be transmitted by radio quickly and effectively, without interfering with the normal flow of messages by way of the other three groups, especially the land-line telephone system.

While this article describes the present status of the WERS in the Summit County Civilian Defense Corps, it is advisable to keep in mind the fact that changes in the organization are being made constantly to meet the needs of the communications service as they develop in our work.

Beginning With Pearl Harbor

Immediately following the Japanese attack upon Pearl Harbor, members of the Buckeye Short-Wave Radio Club held discussions about future emergency radio operations. Under the leadership of John A. Bailey, W8UJB, president of the club and ARRL Emergency Coördinator, preliminary plans were prepared relating to operators and equipment to be used for OCD service. The 2½- and 5-meter bands were agreed upon as being most suitable for emergency radio operation, inasmuch as it was felt that lower frequencies would not be permitted by the FCC (as later proved to be true).

It was during December, 1941, that the Executive Council of the Summit County Civilian Defense Corps appointed John Bailey, W8UJB, representative of the amateur radio operators in Summit County and requested that he submit a tentative plan for using short-wave radio in conjunction with the Communications Section. By virtue of the preliminary work done by the Buckeye Short-Wave Radio Club, W8UJB was able to present a report to the Executive Council which provided for two-way radio communication using sixteen 2½-meter transmitters of both the fixed and the portable type, a survey having indicated that 40 or more amateur operators were available for use in conjunction with the radio arrangement. A more specific plan could not be submitted inasmuch as the Akron organization of the OCD was still in the formative stage.

The East Control Center in operation, Harold Walker, W8LHU, at the controls. Transmitter, modulator and power supply are rack-cabinet mounted. A common antenna is used for transmitting and receiving, with change-over relay. Communications officer occupies the position at right of the radio operator.

*641 E. Buchtel Ave., Akron, Ohio.

This is the story of how the progressive civilian-defense corps of one metropolitan area is preparing to use radio for emergency communication — and not only use it, but place major reliance upon it. "In our planning radio isn't a secondary means of communication," M. M. Konarski, Akron's dynamic, foresighted commander of communications, said in mid-October. "To us it's a *primary* system." There is reason for the municipal confidence in radio in Akron — the hams there have earned it. Read the record of their accomplishments and mark its lessons well.

The tentative plan submitted by W8UJB was favorably received by the Executive Council and he was instructed to apply to the FCC for authority for the construction and operation of a short-wave radio system as proposed. Accordingly, the first application was forwarded to the FCC in January, 1942, requesting authority for twelve operators and necessary transmitting and receiving equipment operating on the 2½-meter band. All operations were to be confined to communications necessary for the proper functioning of the Summit County Civilian Defense Corps and of the municipal government of Akron.

Akron Receives First WERS License Issued

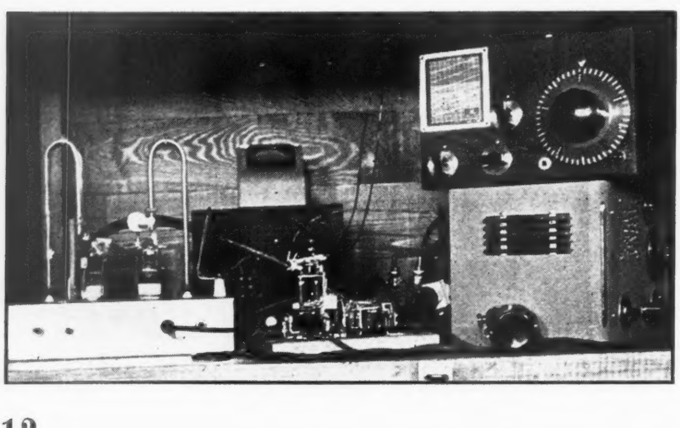
Apparently neither the FCC nor the OCD were prepared for such an application, and there was much correspondence between Akron and Washington relative to the establishment of the system.

However, the WERS station license and operator permits were finally granted on August 25, 1942, the station call being WODF. This FCC authorization was for twelve operators and sixteen transmitters and receivers, five of the transmitters being 25-watt composite units for the central and the four district control centers, four of the transmitters being Abbott TR-4 units for use at the district control centers and seven being Abbott DK-3 transceivers.

The Summit County Civilian Defense Corps area (Fig. 1) includes Summit County and the City of Akron, and the Corps operates in an administrative capacity with respect to this area. The control centers[1] comprising the Summit County Civilian Defense Corps are Central, East, West, North and South. However, the WERS radio system comprises not only these control centers but also district control centers in Barberton, Cuyahoga Falls, Hudson and Medina, Ohio — the system being under the direct authority of the county radio aide, Rex Brown, W8LUT.

After receiving official permission from the Executive Council, the radio amateurs built and installed composite transmitters and receivers in the Akron-area control centers during the summer months of 1942. A negligible quantity of radio apparatus was purchased because the amateurs utilized their own tubes, transformers and other equipment. Of course, all such equipment is voluntarily loaned and placed under the control of the city of Akron for use in conjunction with OCD activities. A sufficient number of portable units — Abbott DK-3s and TR-4s — were purchased by patriotic citizens active in the West control center to equip each of the four sections of Akron with an auxiliary transmitter and receiver (TR-4) for use in the district control center and two DK-3 units for field operations. All transmitters and receivers, whether fixed or portable, are being operated only by qualified

[1] Those familiar with the recommended national OCD plan of operation for the CDC — which was the basis for our previous accounts of WERS organization — will require some explanation concerning the terminology used here. Because of local requirements, Akron and Summit County have a somewhat different set-up for control centers than that specified in the basic OCD plan. By substituting the term "district control center" for "central control center" and "sub-control center" for "district control center" in this article, it will be seen that the organization at Akron is similar to that originally contemplated by OCD — with *one important difference:* that, whereas OCD's original plan provided for liaison of district with sub-control centers primarily for the purpose of transmitting shut-down orders from the Army Interceptor Command, Akron's plan calls for inter-coöperation of the various "districts" in *all* aspects of civilian defense. — EDITOR.



WODF-1 — the Central Control Center station, located in a locked cabinet in a penthouse atop a downtown municipal building and remotely controlled. At left is the tuned-line m.o.p.a. transmitter, in the center the relay group for remote control operation, and at right the receivers. The National 1-10 is used for monitoring by the remote control operator. The 9001-9002 fixtuned receiver (below) is permanently tuned to WERS channel, feeds a speaker at the remote-control position. Power supply is in the background.

radio amateurs holding Class-A or Class-B licenses as well as WERS permits.

At the Central control center the transmitter and receiver are located in an enclosed and locked cabinet in a penthouse on the roof of one of the city-owned buildings in the downtown area. They are remotely controlled from a position in the central control room by the county radio aide on duty at this position, and also may be operated from a second remote control point in an adjacent building under the control of the assistant radio aide. Experience has shown the advisability of stationing a licensed operator in the penthouse for monitoring duties during transmission periods.

In the district control centers, the transmitters and receivers are located in the telephone communications room at the control centers, so that the radio aide and communications officer are in constant contact. Under such conditions, it is absolutely essential to have a minimum of confusion and noise for the best functioning of the radio arrangement. This is a matter on which the radio aide of the control center must inform the commander of the district control.

It has been found advisable to have all components mounted in a closed cabinet which is kept locked at all times, subject to use only by the radio aide and his assistant. This effectively prevents tampering by unauthorized persons.

Resonant-Line M.O.P.A.s at Control Centers

As discussed above, five composite transmitters are used for contact between the five control

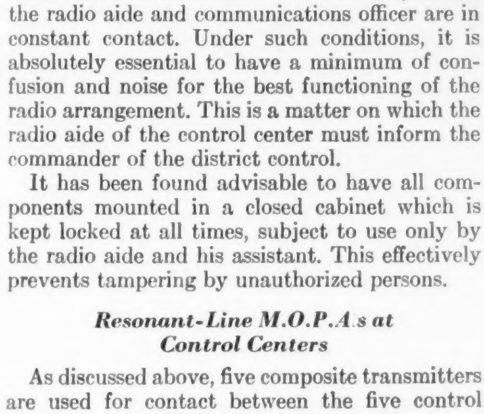


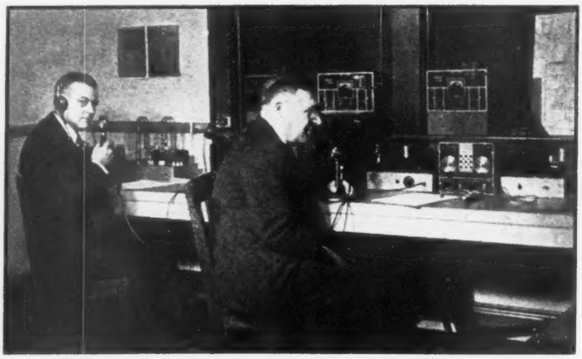
Fig. 1 — The Akron WERS area in relation to the State of Ohio as a whole. Squares represent WERS area headquarters, while triangles within the squares indicate district warning centers. Heavy lines are warning district boundaries, light broken lines WERS area boundaries.

County Radio Aide, Rex T. Brown, W8LUT, making a signal-strength check in the field with one of the mobile units. Distance is three miles from West control, signal strength S9!

centers in the Akron area. These composite units are m.o.p.a.s, with one HY75 as the oscillator and another HY75 as the final amplifier, using resonant-line tanks in both stages. This type of tank, together with the low-capacity high-transconductance tubes, gives performance substantially equivalent to that secured with crystal control. After a 20-minute warm-up period the transmitters drift a negligible amount, making possible a two-hour period of contact among the five stations without retuning the receivers. Modulation is accomplished by a single-button carbon microphone and a single 6L6. Even when using 25 watts input the distortion is within the permissible range, and such a set-up reduces to a minimum the number of parts comprising the transmitter. It also permits the use of one 8 × 12-inch chassis for all the components except the power supply. The simplicity of the circuit made it practical to build the transmitters with a minimum of work and with minimum purchases of additional apparatus over and above that already possessed by the amateurs participating in the program. The most difficult parts to obtain have been the tubes. These, incidentally, may be HY75, HK24, 35GT or similar tubes; any one of these tubes will provide substantially equivalent performance.

The auxiliary transmitters for field contacts from the district control centers are commercially-built Abbott TR-4s. We also now have a license for seven Abbott DK-3 transceivers for contact from the field with the respective district control centers.

The power supplies for the composite units in the respective control centers are made of amateur transmitter components of proved stamina. Our experience has been that these power supplies



The West Control Center firing up for a test. Each center is assigned a permanent quota of auxiliary mobile units (transceivers); spare units may be used at the center for duplicate-channel contact with field groups. Operators are (right) Darley Thurnes, W8BFJ, and (left) Arnold Harvey, W8OJN. Operators (radio aides) and assistants are permanently assigned to their stations at the district control centers. Keen rivalry exists between the teams over general station excellence, tight operating practice, and neatness of quarters.

are adequate for the purpose and have not been overloaded by any WERS activity thus far encountered.

To take care of the eventuality of failure of electrical power at the control centers we have provided five gasoline-driven 115-volt, 60-cycle generators with outputs ranging from 400 to 1,000 watts. Thus, the transmitters and receivers at the central control and each of the four district control centers may be operated despite failure of the supply from the public utility lines.

T.R.F. Receivers

As with many amateurs, the "cart was put before the horse" during the Buckeye Short-Wave Radio Club conferences, which dealt with the subject of a suitable transmitter but discussed no particular receiver. Naturally, this led to another club discussion, as a result of which it was decided to use three National 1–10 receivers which were available and to build three 9001–9002 superregenerative receivers, as described in December, 1941, *QST*. These receivers were built for the Central, North and East control centers. The National 1–10 unit at the Central control center is located at the remote control point in the adjacent building as noted above, and is operated by the assistant radio aide for checking the frequency of the transmissions from the respective district control centers.

In actual performance our experience has been that the 9001–9002 receivers function almost as well as the National 1–10s and are suited for WERS operation since they possess good sensitivity and smooth control. As a suggestion to those contemplating building receivers for WERS use, be sure to add a stage of r.f. Even though it may show only a slight amount of gain, it will prevent objectionable extraneous radiation by the receiver. Naturally, such extraneous radiation is extremely annoying — as was proved to us during a recent test.

Copper-Tubing Antennas

The antennas for the composite transmitters are of the horizontal half-wave type, using ¼-inch copper tubing mounted on 2-inch standoff insulators and fed with a "delta-matched" open line having a 2-inch spacing. Coupling at the transmitter is accomplished by a hairpin coupling loop. The selection of horizontal antennas was dictated partly by the theory that we could obtain good low-angle radiation, provided they were mounted reasonably high above the immediate surroundings, and partly by the fact that they were comparatively convenient to construct, feed and adjust. Because of the need for speed in getting the rigs in operation, we used the dimensional data in the ARRL *Handbook*. It was found that the antennas, as built, function so satisfactorily as to need no further adjustment.

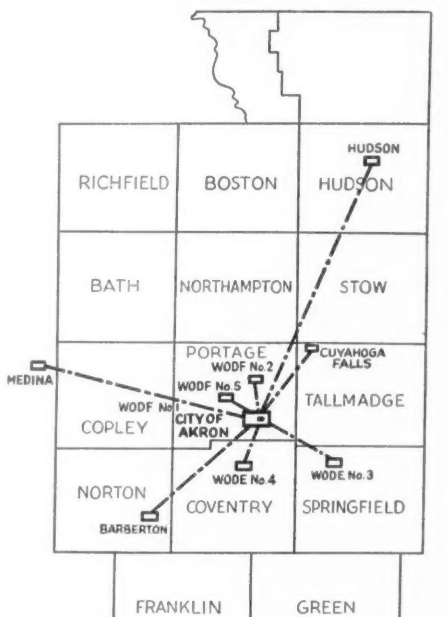
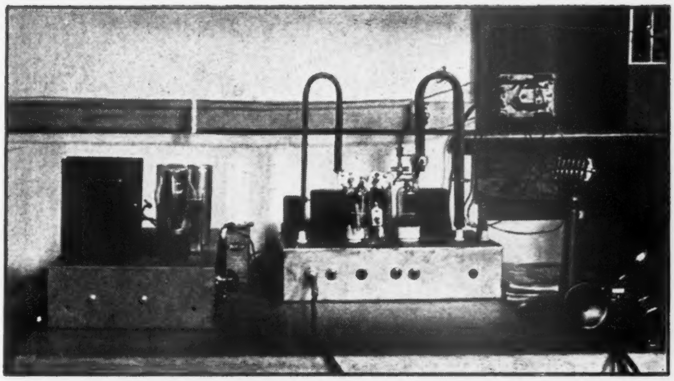


Fig. 2 — Summit County and the existing WERS network. Boundary lines show townships and the downtown Akron area. All Summit County — 419.4 square miles, about 400,000 population — is organized under one CDC command, but the WERS area includes parts of five adjoining counties.

Close-up of the transmitter and power supply at WODF-5 — West control. All control center transmitting equipment follows basic design described by W8UJB on p. 41 of this issue. Only major deviation is here at WODF-5, which uses a 6N7 Class-B modulator instead of the Class-A 6L6s found in the other units.



For the auxiliary Abbott TR-4 transmitters, half-wave radiators fed with ¼-inch i.d. concentric line are used, the top quarter section being a continuation of the inner conductor and the bottom quarter being a 1-inch i.d. copper-tube skirt electrically and mechanically joined at the end of the concentric line tubing. During a recent check transmission using an Abbott DK-3 equipped with a quarter-wave vertical rod and operating at a distance of approximately 15 miles from the Central control center's horizontal antenna, the signal from the Central control center was inaudible when the antenna was in the vertical position and S6 to 7 when in the horizontal position — in other words, having the same polarization as the transmitting antenna.

Good results have been secured with the present arrangement, as shown by the fact that the Central transmitter's signal was picked up at a good, readable signal level in Medina and Hudson, Ohio, a distance of approximately 21 miles, when using the horizontal half-wave antenna. However, we are now constructing a three-element fixed-beam antenna for these more distant transmissions. It is believed that even better results will be secured with the beam antenna.

Personnel

Before receipt of the WERS license and before active operations were undertaken in the Fall of 1942, John Bailey was called for duty as an officer in the U. S. Army Signal Corps. In view of this, Rex Brown, W8LUT, was appointed County Radio Aide on August 15, 1942. Two WERS-licensed amateurs have been appointed for each district control as radio aide and assistant, respectively, and two assistant radio aides have been appointed for the central control headquarters. These are as follows:

At Central Control — Radio Aide, Rex Brown, W8LUT; Assistant, Paul Blanchard, W8GCI; Assistant, D. L. Moody.

North — Radio Aide, L. F. Strobel, W8BSR; Assistant, S. F. Carr, W8UGF.

East — Radio Aide, Harold W. Walker, W8LHU; Assistant, Ray Ewing, W8PVW.

West — Radio Aide, Darley Thurnes, W8BFJ; Assistant, J. M. Trutko, W8EXI.

South — Radio Aide, Herman Freeder, W8VQI; Assistant, Paul E. Biddison, W9TVZ.

Other radio aides have been officially appointed for Barberton, Cuyahoga Falls, Hudson and Medina, Ohio, as follows:

Barberton — Radio Aide, L. H. Miller, W8NYY; Assistant, P. E. Buchtel, W8JTI.

Cuyahoga Falls — Radio Aide, J. T. Ashworth, W8DRL; Assistant, D. E. Worrel, W8CLO.

Hudson — Radio Aide, H. L. Steffan, W8RHZ.

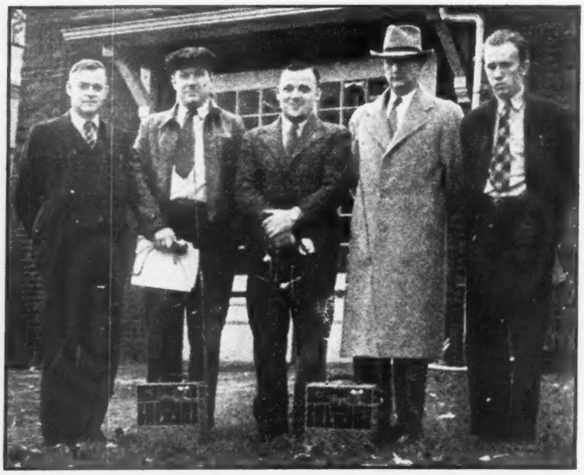
Medina — Radio Aide, Karl Rau, W8KNF; Assistant, Victor Smith; Assistant, H. J. Kohli; Assistant, V. P. Lutz.

Most of the communications officers in the respective district and central control headquarters were experienced radio amateurs. Consequently these men were especially qualified by virtue of their prior experience, and were subsequently appointed radio aides.

Field Tests

Upon receipt of the FCC licenses, test transmissions were held regularly in accordance with the WERS regulations, utilizing not only the fixed composite apparatus but also some of the portable units. A negligible amount of adjustment was required to establish satisfactory transmission between all of the Akron control centers, indicating that a very workmanlike job had been done. It was found possible during these tests to communicate from the central control to any of the district control stations and any of the district control stations could make contact with each other, with excellent signal strength.

A program is now in execution for securing signal-strength readings at selected points in all of the districts for future use by the portable-unit operators when in the field. These operators will then know the points within their territory from which satisfactory communication may be had with their district control center. Each of the



The day may be cloudy and wet, but the field-strength checking crew sets out with their mobile auxiliaries just the same. *Left to right* — Arnold Harvey, W8OJN (West); Harold Walker, W8LHU (East); James Trutko, W8EXI (West); Leonard Strobel, W8BSR (North); and Robert Wyatt, W8QYP.

portable-unit operators will be furnished with a field-strength diagram for his district or patrol area, such as that shown in Fig. 2.

In connection with the portable units, in keeping with the current shortage of replacement parts difficulty has been experienced in obtaining batteries for the Abbott DK-3s. For this reason, these units are now being converted to use a vibrator power supply operating from a storage battery. This results in two distinct advantages: (1) a saving in dry batteries, and (2) an appreciable gain in signal level when operating from an automobile using a grounded vertical quarter-wave antenna.

Additional Operators

The matter of securing operators for the increased number of portable units which we eventually expect to have in each of the district control areas has received serious consideration. There were approximately 300 licensed amateurs in the Greater Akron area before World War II started. It is estimated that we now have approximately 70 per cent of these amateurs available. A survey has shown that substantially all of the amateurs remaining are busily engaged in manufacturing establishments producing war products, and many of these amateurs are working seven days each week. This means that we shall have difficulty in securing enough licensed amateurs holding Class A or B tickets to take care of our present plan of expansion of WERS activities. In view of this shortage of experienced and capable operators, it is our intention to begin classes within the next several weeks for training men, and possibly women, whereby they may secure a restricted radiotelephone operator's permit. We propose to use the plan described in the October, 1942, issue of *QST* entitled, "Training Auxiliary Operators for WERS."

Organization

In the early operation of the Akron OCD system, the field men in the Central control district reported directly to the North district control which in turn relayed the information to central control. However, the field men in the other districts, including North, reported directly to their district control center. This meant that an air raid warden, for example, telephoned his message to the district control and the district control then relayed it by telephone to the central control. Naturally, such an arrangement soon has all telephone lines in operation and a saturation point is reached very quickly, hence undue delays occur in receiving and giving orders.

For this reason, the radio set-up has been given a definite part in the present functioning of the Akron OCD, particularly with respect to messages for the central control police and fire commanders, who exercise authority over the regular and auxiliary city police and fire squads. Open telephone lines from each of the four Akron district control centers to central control are available for messages to the police and fire commanders. However, as discussed subsequently, radio

(*Continued on page 116*)

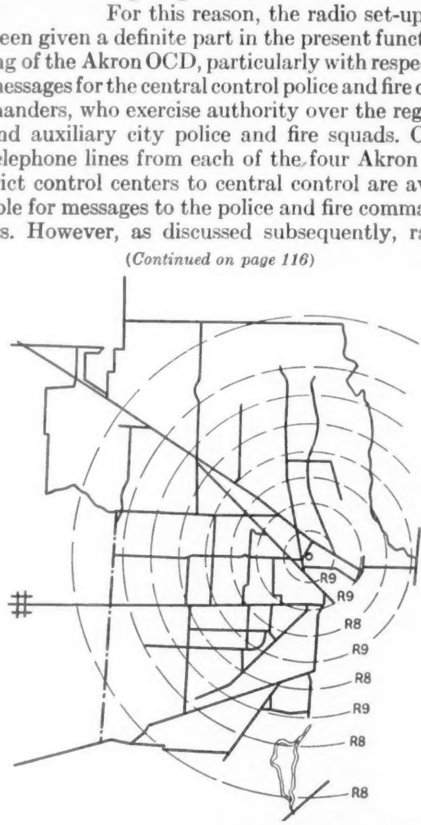


Fig. 3 — Typical field-strength map, showing signal pattern around WODF-5 based on actual tests between mobile units and the control station. Such maps are prepared for all district (sub-control) centers for the guidance of mobile-unit operators.

Standing Waves on Transmission Lines

A Method of Line Matching Based on Graphical Comparison

BY T. A. GADWA, SC.D.,* W2KHM

STANDING waves are often a problem to amateurs who attempt to use untuned transmission lines for their antennas. The elimination of these waves is often difficult because of a lack of understanding of the principles involved. Using the analogy of water waves in a canal is often helpful in visualizing the factors that influence the operation of transmission lines. Suppose the canal has a dam at one end and a wave is created at the opposite end. This wave traveling toward the dam is reflected back to the starting point. Now if the height of the dam is lowered sufficiently to allow the initial wave to splash over, then no return wave or reflection is produced. In the radio-frequency application, the canal corresponds to the transmission line and the dam to the load or antenna.

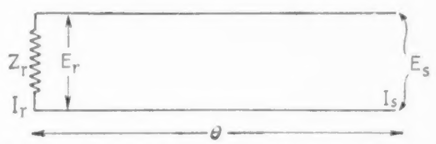


Fig. 1 — Section of transmission line with its terminating load.

Terman [1] has analyzed the position and magnitude of standing waves on lines for several different types of loads. Everitt [2] has derived equations that make it possible to establish the character of these waves. If one neglects the line losses, which are usually small for relatively short lengths of line, the calculation is simplified considerably. At radio frequencies, such lines may be assumed to behave as pure resistances. The current at any point on the line for any type of load is given by the equation:

$$I_s = I_r \left(\cos\theta + j\frac{Z_r}{R_o}\sin\theta\right) \qquad (1)$$

The voltage at any point is given by the equation:

$$E_s = E_r \left(\cos\theta + j\frac{R_o}{Z_r}\sin\theta\right) \qquad (2)$$

where I_s = current at any point in the line
I_r = load current at output or receiving end of line
E_s = voltage at any point on line
E_r = voltage at output or receiving end of line
Z_r = load impedance
R_o = characteristic impedance of line
θ = distance from point to output or receiving end of line
2π radians = 360° = 1 wavelength

$j = \sqrt{-1}$ indicating 90° phase shift
$+j$ for inductive reactance
$-j$ for capacitive reactance

The load may be any of the combinations shown in Fig. 2. The character of the standing waves that are associated with each case will be discussed.

If a voltage is applied or a current induced at the sending end of a transmission line and the receiving end is an open circuit, a wave traveling toward the open circuit is reflected wholly since no power is absorbed. This reflected wave combines with the incident wave to form standing waves. Waves that can be measured as average values of current or voltage are called standing waves. The readings are all positive since no account is taken of phase between the current and voltage. The results are represented as positive values plotted as ordinates above the horizontal axis. At the open circuit, the voltage is reflected in phase since the incident and reflected voltages are equal and their sum is not zero, while the current is reflected out of phase since the incident and reflected currents are equal and their sum is zero. If the average current or voltage along the line is measured, maxima and minima are found at regular intervals from the receiving end of the line. The current distribution for an open circuit is shown in Fig. 3-1. Only a half wavelength is shown as the cycle is repeated for additional lengths of line. To avoid confusion that might result if voltage were superimposed, only the current wave-forms are plotted. There

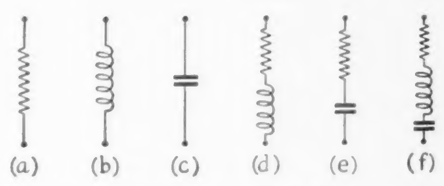


Fig. 2 — Possible combinations of resistance and reactance which may make up the load impedance, Z_r.

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[1] Terman, *Radio Engineering*.
[2] Everitt, *Communication Engineering*.

is always a current minimum or node at the receiving end and at every half-wavelength point back along the line, and a current maximum or loop at every quarter wavelength. Furthermore, the voltage is maximum or a loop at each current minimum or node and there is a voltage minimum or node at each current maximum or loop. It is evident that maximum and minimum values of either voltage or current occur exactly $\frac{1}{4}$ wavelength apart.

If the receiving end is short-circuited, a wave starting down the line is reflected and again standing waves are found. Here the positions of the maximum and minimum have been shifted and appear as in Fig. 3–2. At the short circuit, the incident and reflected voltages are out of phase and their sum is zero, while the current is reflected in phase and the sum of the two components is not zero.

If an appropriate pure resistance equal to a constant known as the characteristic impedance of the line is connected as a receiving load, a wave starting down the line is absorbed completely and no reflection is possible. The current and voltage are constant at all points, with no maximum or minimum, as shown in Fig. 3–5. Since all actual lines have losses, the current and voltage diminish slowly toward the load, as indicated in Fig. 3–6. Such lines are known as flat lines. This load impedance is dependent only on the physical properties of the line: the conductor diameter, conductor spacing and type of insulation or dielectric. Its value for an open-air two-wire parallel line is calculated by the formula:

$$R_o = 276 \log 2S/D \qquad (3)$$

where R_o = characteristic impedance of line in ohms

S = spacing between conductor centers in any units.

D = diameter of one conductor in same units

If the load resistance is less than the line impedance but not a short circuit, the standing waves are similar to the short circuit load except that the minimum current is greater than zero, as shown in Fig. 3–4. If the load is made greater than the line impedance but not infinite (open circuited), the standing waves are as shown in Fig. 3–3. It is evident that the maximum and minimum currents occur in the same positions as in the case of the open-circuit load, but the maximum-to-minimum ratio is less. The ratio approaches the value of unity as the load approaches the characteristic impedance.

If the load is an inductive reactance equal to the characteristic impedance, Fig. 2-B, no power is absorbed and standing waves are as shown in Fig. 3–9. The line behaves similarly to a short-circuit load except that the waves are shifted toward the receiving or load end. The current is zero at $\frac{1}{8}$ wavelength from the load and maximum at $\frac{1}{4}$ wavelength farther along and then every $\frac{1}{2}$ wavelength to the sending end. As the inductive reactance is increased from values less than to greater than the characteristic impedance, the standing waves are shifted toward the receiver or load end as can be seen by comparing Figs. 3–7, 3–9 and 3–11.

When the load is a capacitive reactance, Fig. 2-C, equal to the characteristic impedance, no power is absorbed and standing waves are present in the form given in Fig. 3–10. The line behaves similarly to an open circuit except that the standing waves are all shifted toward the receiving or load end. A current maximum occurs at $\frac{1}{8}$ wavelength from the load and every $\frac{1}{2}$ wavelength toward the sending end of the line. As the capacitive reactance is reduced from greater than to less than the characteristic impedance, the standing waves are shifted toward the receiver as can be seen by comparing Figs. 3–12, 3–10 and 3–8.

There are many other possible combinations of resistance in series or parallel with either or both inductive and capacitive reactances, Figs. 2-A to 2-F. This discussion is confined to series circuits, since any parallel circuit can be transformed into an equivalent series circuit. Theoretically there are $4 \times 4 \times 4 + 2$ or 66 combinations where the individual components are less than, equal to or greater than the characteristic impedance. A series circuit of resistance, capacitance and inductance behaves like a resistance in series with either inductance or capacitance, depending upon the frequency, except at resonance where it is resistive only. This limits the actual number of cases to $3 \times 3 \times 3 + 2$ or 29. For series loads of resistance and inductance, the wave forms are given in Figs. 3–13 to 3–21. For series loads of resistance and capacitance, the wave forms are given in Figs. 3–22 to 3–30.

If the load is composed of resistance and reactance whose total impedance is equal to the line impedance, the maximum or minimum current or voltage always occurs at exactly $\frac{1}{8}$ wavelength from the receiver load, regardless of the resistance to reactance ratio. This can be seen by comparing Figs. 3–31, 3–32 and 3–33 for inductive and resistive loads and Figs. 3–34, 3–35 and 3–36 for capacitive and resistive loads. The maximum-to-minimum ratio of current or voltage approaches unity as the resistance-to-reactance ratio increases.

When the total load impedance and the resistance component are each greater than the line impedance, an increase in inductive reactance shifts the waves back from the load end, as can be seen by comparing Figs. 3–19, 3–20 and 3–21. Similarly, a decrease in capacitive reactance shifts the waves back from the load end, as can be seen by comparing Figs. 3–30, 3–29 and 3–28. This effect of reactance change upon wave shift is in the opposite direction to the shift obtained with reactance loads only.

With a series inductive reactance and resistance load whose total impedance is greater than the characteristic impedance, the minimum current is always less than ⅛ wavelength from the receiver.

With a series capacitive reactance and resistance load whose total impedance is less than the characteristic impedance, the maximum current is always less than ⅛ wavelength from the receiver.

Some of the curves for current may be applied for the distribution of voltage as well. The line current for the open circuit load is also the line voltage for a short circuit load. The line current

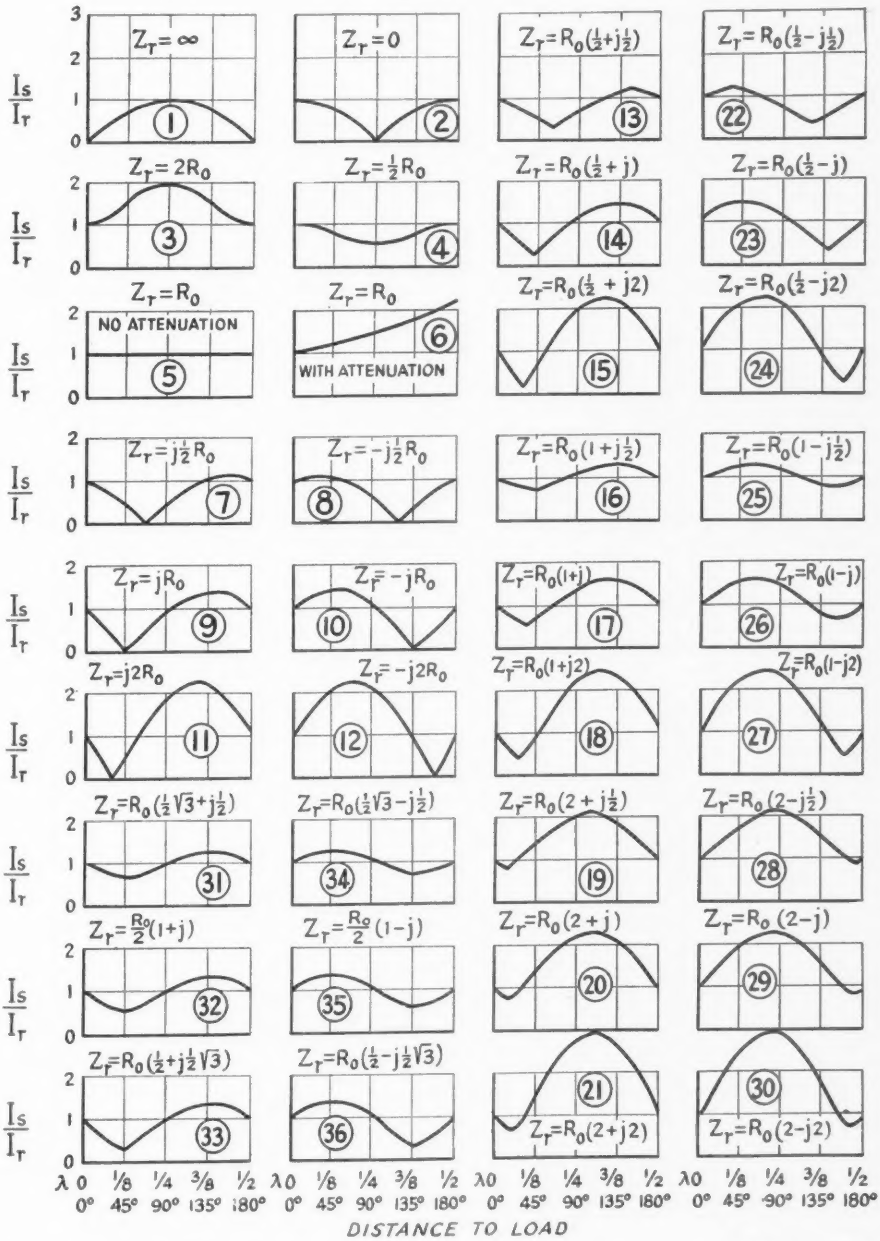


Fig. 3 — **Positions and relative magnitudes of standing waves for various load impedances. The curves show the ratio of current at the point on the line considered to the current in the load.**

for the short circuit load is also the line voltage for an open circuit load. Similarly, Fig. 3–22 represents the voltage for load conditions in Fig. 3–17 and vice versa. Also Fig. 3–26 represents the voltage for load conditions in Fig. 3–13 and vice versa. The voltage and current at some points on the line may rise above the sending and receiving values because of the resonant effect of the transmission line.

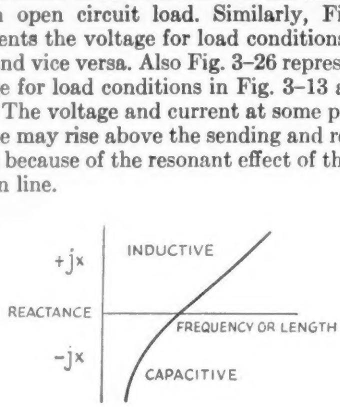


Fig. 4 — Reactance variation in a series-resonant circuit.

Matching the Antenna

An antenna is a series-resonant circuit and may act as a load for the transmission line. In most cases it is inconvenient or impossible to secure a direct match between the line and antenna. It is then necessary to insert some sort of impedance transformer between the antenna and receiver terminals of the line in order to present a load equal to the line impedance. An antenna acts like a pure resistance at resonance, is capacitive and resistive at lower frequencies, and is inductive and resistive at higher frequencies; or, for a given frequency, the antenna is capacitive and resistive if too short and inductive and resistive if too long. The reactance of a series resonant circuit is shown in Fig. 4. The resistance of an antenna changes with frequency or length and is maximum at resonance. The resistance and reactance of an antenna may also be represented as shown in Fig. 5.

Before it is possible to obtain an impedance match and a flat line, the antenna must be tuned to resonance either by adjustment of its length or by inserting a series inductance if too short or a series capacitance if too long. The recognized method is to excite the antenna parasitically and obtain maximum antenna current by tuning. This is laborious and requires accurate measuring equipment. Neither can the exact length of the antenna be calculated for resonance. Many avoid this step by erecting the complete antenna system and attempting to obtain a flat line by trial and error in antenna tuning and impedance-transformer adjustments. This procedure may result, in rare cases, in obtaining a flat line. It is evident that the number of variables is too numerous to achieve the desired results with a minimum of experiment. At this point a working knowledge of standing waves will enable one to establish the condition of the antenna or the transmission-line load. A scheme is proposed whereby, after determining the relative magnitude and position of the maximum and minimum or loop and node of voltage or current, the antenna condition is indicated by comparison with various curves for different types of loads.

The complete set of curves shown in Fig. 3 covers all possible combinations of loads that may be encountered. By the recognized mathematical methods of differential calculus, the maximum and minimum positions have been calculated by differentiating the line current I_s of equations (1) and (2) with respect to the distance θ, equating to zero and solving for θ. Some of these equations are of second degree and require solution by the quadratic equation method.

The idea in adjustment is to shift the minimum or maximum current to the ¼ wavelength position (to eliminate the reactive component) and then to reduce the maximum-to-minimum ratio to unity by impedance transformer adjustment. The procedure is to supply sufficient power to the transmission line, with the antenna system in position, to permit measurement of the line current or voltage, starting at the load if possible, and then by measurement at equal small intervals to establish the location of the maximum and minimum voltage or current. In most cases it is preferable to locate the current nodes or minima rather than the voltage, because the change in current per unit length of line is more rapid and easier to detect. One-sixteenth wavelength intervals are sufficiently close to enable one to plot a curve of current or voltage vs. distance to the load. If it is impracticable to start at the load it is permissible to begin at any multiple of a half wavelength from the load, since the standing waves are repeated along the line to the sending end. Radio-frequency waves travel more slowly on transmission lines than in air, so that the length of a wavelength for an open-wire line is usually about 97.5 per cent of that in air.

If maximum or minimum current or voltage occur at points other than at multiples of ¼ wavelength from the load, the antenna is non-resonant and must first be tuned to resonance by whatever method is desirable. If the maximum current occurs between the load and ¼ wavelength, the antenna is capacitive or too short and must be lengthened or series inductance added.

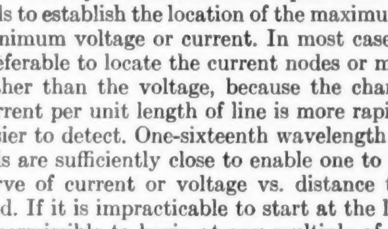


Fig. 5 — Resistance and reactance variation in an antenna, looking into a current loop.

If minimum current occurs between the load and ¼ wavelength, the antenna is inductive or too long and must be shortened or series capacitance added. If maximum or minimum current or voltage occur at ¼ wavelength from the load, the antenna is resonant but the impedance match is incorrect. The impedance transformer then should be adjusted until the maximum and minimum values are equal or the standing wave ratio is unity.

All the wave forms shown can be encountered during the process of tuning the antenna and matching the line impedance. As the antenna approaches resonance and the impedance match becomes nearly correct, the waves may look like Figs. 3–16 or 3–25. Poor adjustments may yield waves like Figs. 3–21 and 3–30.

It must be emphasized that no adjustment at the sending or transmitter end of the line will change the position of the standing waves. This adjustment will only control the degree of coupling and the amount of power delivered to the line and antenna. A reactive component always appears at the sending end if standing waves are present. It is evidenced by the necessity for resetting the plate tank tuning capacity to obtain minimum plate current when the line is coupled. All adjustments must be made first to the antenna and then to the impedance transformer for the elimination of standing waves. For efficient reception, a proper impedance match must be made at the receiving end. In this case, the antenna is at the sending end and the receiver at the output of the line.

With this approach to the standing wave problem, that elusive flat line should be easily realized by all amateurs using untuned transmission lines for their antennas.

New Tubes

RCA has recently announced seven new tubes of various types as follows:

The 5R4-GY is a coated-filament type of full-wave high-vacuum rectifier having a maximum peak plate current rating of 650 ma. and a maximum peak inverse voltage rating of 2800 volts. In typical application, the d.c. output-current ratings with a condenser-input filter are 250 ma. and 150 ma. maximum respectively at r.m.s. voltages per plate of 700 and 900. With choke-input filters, the maximum d.c. current ratings are 250 ma. and 175 ma. for r.m.s. plate voltages of 750 and 950 respectively.

The 6AG5 is a heater-cathode-type r.f. pentode of miniature construction. Its characteristics exhibit sharp cut-off and high mutual transconductance. It is useful in compact light-weight equipment as an r.f. amplifier up to about 400 Mc., and as a high-frequency intermediate amplifier. It has low input and output capacities. It has a 7-pin miniature glass-button base and the heater operates at 6.3 volts, 0.3 ampere.

The 6J6 is a miniature twin triode, with glass-button base, having two grids and two plates with a common indirectly-heated cathode. The units may be operated in parallel or push-pull. With the push-pull arrangement of the grids, and with the plates in parallel, the 6J6 is particularly useful as a mixer at frequencies as high as 600 Mc. It is also useful as an oscillator. As a Class-C r.f. amplifier, the tube is capable of a power output of 3.5 watts when operated at a plate voltage of 150 and plate current of 30 ma. Heater ratings are 6.3 volts, 0.45 ampere.

The type 2AP1 is a 2-inch high-vacuum cathode-ray tube similar to the type 902 except that it has separate leads to all deflecting electrodes and the cathode, employs a magnal 11-pin base, and can be operated with anode voltages up to 1100.

The 1C21 is an ionic-cathode, glow-discharge triode designed for use primarily as a relay tube. The discharge can be initiated with a very small amount of energy applied to the grid circuit. It is similar to the type 0A4G but is more sensitive.

The type 934 is a small high-vacuum phototube intended primarily for use in sound and facsimile equipment, but it is also suitable for light-operated relays and light-measuring equipment. Its S4 photosurface has exceptionally high response to blue and blue-green radiation and negligible response to red radiation.

The 935 is a high-vacuum phototube possessing extraordinarily high sensitivity to radiant energy rich in blue and near ultraviolet and will respond in the region down to about 2000 Angstrom units. Because of its excellent stability, consistency of spectral response, and extremely high sensitivity, it is particularly suited for use in measuring ultraviolet absorption of gases and liquids.

National Union has announced two new special receiving types as follows:

The type XXFM is a twin-diode triode, with heater ratings of 6.3 volts, 0.3 ampere, designed to operate at triode plate voltages between 100 and 250 volts. The two diode units are designed for special detector circuits and are wired such that the cathode of one diode unit is common to the triode cathode, while the cathode of the second diode unit is brought out to a separate pin. The amplification factor of the triode is between 85 and 100 and the transconductance 1000 to 1500 μmhos.

The type XXB is a twin-triode frequency converter with a double-section heater which may be operated with the sections in series at 2.8 volts, 0.05 ampere, or in parallel at 1.4 volts, 0.1 ampere. Designed to operate at a plate voltage of 90, the amplification factor of each section is 14.5 and the transconductance approximately 1300.

In the Field With the Signal Corps

A Picture-Story of U. S. Army Field Radio Equipment

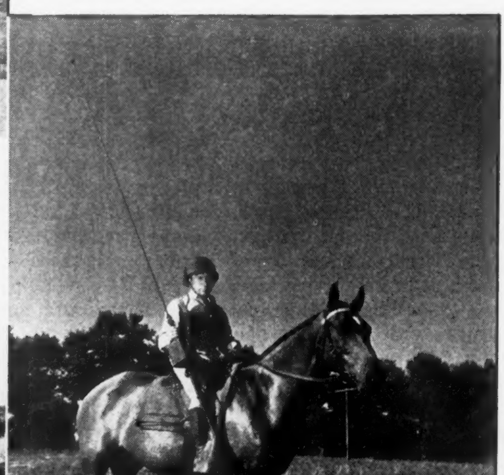
On these pages are pictured some of the types of field radio equipment now employed by the U. S. Army, ranging from the paratrooper's "handie-talkie" to powerful motorized trailer-truck base sets. This is Signal Corps equipment — highly developed, each type especially perfected for its own individual job by intensive field trials and the acid test of actual military operation.

It is this equipment which the hams (and the thousands of will-be hams who are now their buddies) in the Signal Corps are learning to use in training camps around the nation. It is the equipment some of them have already set up on foreign soil and operated in actual combat with the enemy.

Thousands of these units are now in operation. Thousands more are pouring from the production lines weekly. On these units, and the men who operate them, rest a vital responsibility. For the performance of the army in the field can be no better than the equipment it possesses. And in modern warfare communications constitutes the nerve system indispensable for coördination and control of successful operations.

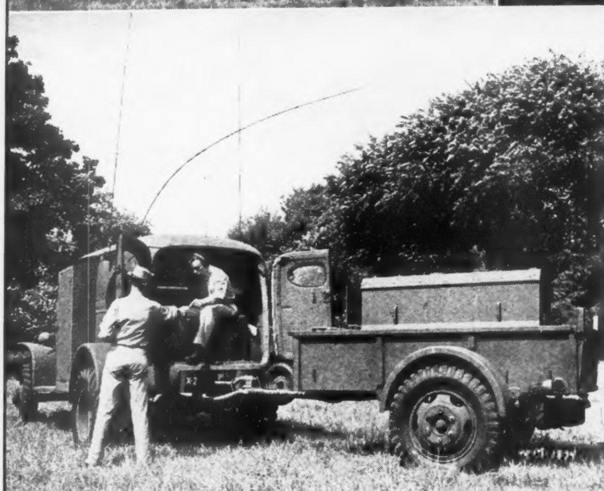
This, then, is the equipment with which the Signal Corps will do its part to win the war.

Left — The "handie-talkie" fits its name in every sense of the word. Smallest field unit of the Signal Corps, it is not much larger or heavier than a conventional handset. ***Lower left*** — Two midgets — and both tops in their class. A jeep and a handie-talkie on reconnaissance duty. Operator is strapped in by safety belt for travel over rough terrain. ***Below*** — Cavalry "guidon radio." Although designed for mounting in a stirrup-boot, it can also be used by a soldier on foot or mounted on a vehicle. ***Official U. S. Signal Corps Photos.***

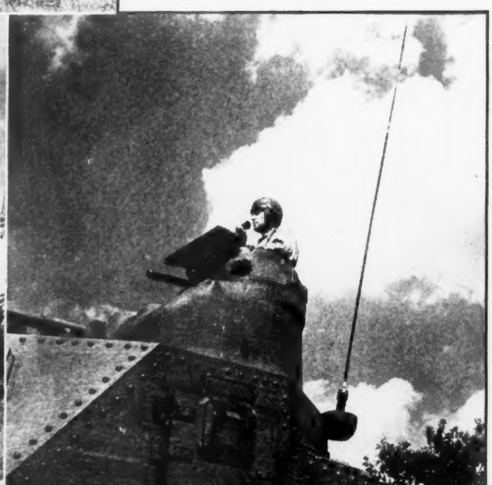





Portable field equipment for all branches of the service. *Upper left* — Workhorse of the Signal Corps is this BC-191-type transmitter, seen here in typical operation at a field post. Remotely controlled from central receiving point (shown at center left). *Upper right* — Compact 'phone-c.w. field unit with transmitter and receiver in the same cabinet, using dynamotor power supply (underneath). *Center left* — Remote-control operating and receiving position with two complete channels. Transmitters (see photo at upper left) are remotely controlled for break-in. *Center right* — Next step above the hand portables is this small 'phone-c.w. medium-frequency hand-generator-powered combined transmitter-receiver. Readily transported by a two-man crew, one to operate and one to crank. *Lower right* — On the alert. Fully armed and carrying complete packs, Signal Corps men in combat operate a portable field transmitter under protective cover. *Official U. S. Signal Corps Photos.*



Upper left — SCR 197 field-base unit. The high-power rack-mounted transmitter installed in the truck, complete with power source, may be remotely-controlled from trailer at message center. *Upper right* — Antenna adjustment on the SCR 197's massive vertical, supported by husky ceramic mounting insulators. *Center left* — SCR 299, latest field-base unit. Transmitter and receiving position in truck, gas-driven generator in trailer. The flexible "trolley"-style vertical antenna can be pulled down horizontal from the interior in transit, or the station can be operated in motion at high speed. *Lower left* — Radio-equipped half-track for attack communication in the armored forces. *Lower right* — Talking back from a tank. Note the spring-mounted whip-type vertical with its husky base support. *Official U. S. Signal Corps Photos.*



Upper left — Civilian radio mechanics from the Signal Corps General Development Labs making a radio installation in an M-3 tank. This is some of the latest f.m. equipment for the armored forces. Yes, there are women in the Signal Corps, too! *Upper right* — Another girl mechanic running a field test on a mobile unit. There's a close-up of the spring-type vertical antenna base mounting, too, in case you didn't notice. *Center right* — It's not all radio in the Signal Corps. Here is a soldier cutting a transcription in a Signal Corps sound truck. *Lower left* — The wire men play a vital part, too. Field telephone lines to combat units terminate at this portable command-post switchboard, its operator in full battle dress. *Lower right* — A wire-laying crew in action. They can lay 30 miles of telephone cable a day. *Official U. S. Signal Corps Photos.*

How to Design a Swoose

Meet Your Miscellaneous Needs with a Junk-Box Special

BY C. B. WOLFE,* W9LJO

In building a Swoose, there's only one cast-iron rule — everything in it has to come from the junk box. From there on your scope is limited only by the size of your collection of cast-offs.

Nothing surpasses the tingle of anticipation that comes with opening boxes of shiny new condensers and transformers and carefully removing the tissue wrappings, shelling resistors and sockets out of envelopes and onto the work bench, or moving the parts around on a satiny chassis like chess on a chessboard, to find *just* the perfect arrangement.

"Not available for the duration" in the advertising of a favorite manufacturer strikes a certain chill into any ham's heart, despite the fact that we're all mighty thankful American industry is responding to the country's war needs in an all-out manner. But cheer up — where there's a will there's a way, and that way points to the junk box.

The soldering-iron wizard who has confined his activities to the blueprinted product of someone else's designing is missing something — although it is impossible to do radio construction, even with the most obvious instructions and components exactly as listed, without learning something of the engineering and designing back of the plans. Nevertheless, the amateur who has never bothered to reason why, but just to solder and to try, has plenty of opportunity to learn radio fundamentals from the junk box. In the junk-box way, it is frequently necessary to alter design, substitute components, make some of them over, or to create them from something else.

Most hams have a large collection of salvage from broadcast receivers of various vintages. We did. We had a system — choice pieces of junk were put in cabinet drawers or shelves according to kind. Less desirable junk and chassis yet to be demolished reposed on the basement shelves where it would be handy. The doubtful junk gathered dust in the garage.

It wasn't patriotic, and it was messy. After the shutdown all the junk was dismantled and the mounting piles of screws, bolts, nuts, washers, condensers, resistors, coils and stuff was amazing. Out of the residue grew an idea.

A test oscillator of some kind for lining up superhets had long been needed. Another desired piece of equipment was a small power supply with the output arranged conveniently for experimental work. And a few watts of audio always comes in handy. And so the "Swoose" was born.

You know, " . . . half swan, half goose, Alexander is a Swoose."

Instead of building a number of separate units all were constructed on one chassis, and the "Swoose" is now a little of everything. With an old sloping-panel Day-Fan chassis as the starting place, a new tin "floor" was screwed into place and a sheet-iron panel substituted for the original bakelite one. A tin cabinet with a hinged lid was made and the whole unit given a coat of gray crackle. Nine 'phone tip jacks were mounted an inch apart on a strip of bakelite and protrude through larger holes in the metal panel for the input and output circuits.

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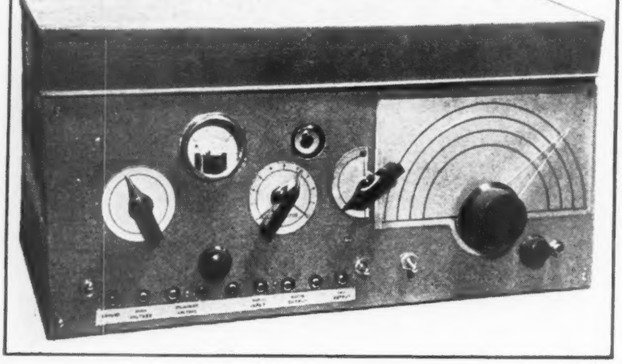
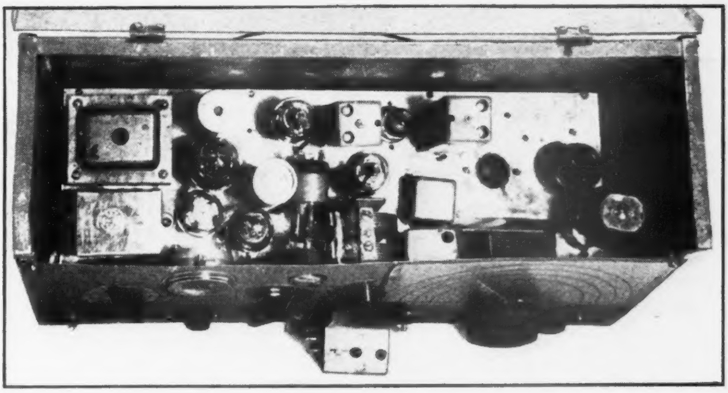


The "Swoose," constructed on an old Day-Fan chassis, almost entirely of junk parts, includes a power supply with tip jacks for use in experimental work, a small audio system, a test oscillator which can be keyed or modulated, and a superhet.



The power supply is at the left-hand end of the chassis, with the audio section in front of it. The superhet with the oscillator and antenna coils mounted on tube bases is in the center, while the test oscillator, with an 8-inch diameter dial, is at the extreme right. The tuning-eye tube is above and slightly to the left of the superhet's tuning condenser. The empty socket back of the oscillator condenser is for a voltage regulator not yet completed.

The power supply is made with a husky old transformer that delivers 350 volts with condenser input, using an 80 rectifier. The choke is in the negative lead, and a single-pole, double-throw toggle switch connects the filter condensers' positive terminals to the high voltage circuit or shorts them to ground, furnishing an a.c. note to the oscillator when desired, and a milliammeter also in the negative lead registers total current consumption of the units in use or any external unit plugged into the high-voltage output jacks.

Two of the 'phone tip jacks are for 6.3-volt filament voltage used externally.

An oscillator similar to the test oscillator shown on page 367 of the 1942 Handbook was added on the other end of the chassis. It uses a 6L6G, however, with the screen and plate connected together for triode operation. It also operates very nicely with 6F6, 6C5, 6J5 and other tubes. The tuning condenser is one of the old original Day-Fan variables. A pointer cut from an old celluloid triangle and a dial plate of silver cardboard with semicircles inscribed with drawing ink and compass, the largest with a diameter of 8 inches, gives a reasonable amount of spread for calibration of the desired bands.

A couple of stages of audio were added; they happen to be a 76 into a 41, just because they were handy. The input and output are "piped" to the tip jacks on the front of the panel, and the output also goes to an audio output transformer that works satisfactorily as a plate modulation transformer into the oscillator. The input also goes to the 6B7 second detector-first audio stage which was later built into the superhet section. The control grid of the 6B7 is fed when using a dynamic microphone. It was originally planned to use the audio for intercommunication between the ham shack and the kitchen, and modulating the oscillator was an afterthought, the idea dawning that it would be comparatively simple to broadcast to any nearby receiver, with either a mike or phono pick-up on the front end.

The idea from the time of its conception through construction has been to make this junk-box Frankenstein as versatile as possible. And although the opportunity has not yet presented itself, it is presumed the oscillator would work satisfactorily for induction field communication, although a bit puny for wired wireless. Nevertheless, provision for wired wireless has been made in the "Swoose" by the addition of a superhet section. In place of constructing a low-frequency converter for the wired wireless (see *QST* for March, 1942, and succeeding issues) a 6K8 oscillator-mixer stage, 6K7 i.f. and 6B7 diode detector-audio were tacked on, feeding it into the audio stages already constructed. The superhet consists largely of the antenna, oscillator and i.f. coils and transformers, and tuning condensers of a car radio previously dismantled. The coils have been mounted on tube bases, cut clear down to the bottoms to shorten leads, making it possible to wind plug-in coils for other bands. No difficulty is experienced in tracking on the broadcast band, and it is hoped coils can be wound for the low frequencies that will track reasonably well.

As each unit was added the combination of uses multiplied. The audio permits the use of the unit as a low-powered p.a. system. Modulating the oscillator allows its use at a school, church or other public gathering, feeding it into a number of radios scattered around at nearby strategic points, rather than a wired speaker system. (Watch this one, fellows, to be sure power does not exceed the FCC regulations. It is impossible to pick up this particular oscillator in a broadcast receiver only 20 feet away, unless some kind of a wire is in the output jack.) The addition of the superhet makes it possible to feed a favorite program from the "Swoose" into another receiver, since the super feeds into the audio which in turn modulates the oscillator. Eventually it is hoped an old (it must be used!) crystal pick-up and turntable can be found and built into the lid of the cabinet.

With a key plugged into the oscillator this unit can be used for code practice into a nearby receiver.

(Continued on page 114)

U.S.A. CALLING!

VOLUNTARY ENLISTMENTS

If you possess an amateur radio operator license, you can enlist direct in the following branches of the armed services:

In the Signal Corps for duty as an operator or technician. Age limits, 18 to 50.

In the Marine Corps as a staff sergeant in the Aircraft Warning Service. Age limits, 17 to 35.

In the Army Air Forces (unassigned) as radio operator or technician. Age limits, 18 to 44.

In the Air Transport Command as radio operator, to be sent to the Replacement Center at Las Vegas, N. M., for training. Age limits, 18 to 44. You must get a letter from the Air Transport Command to take to your recruiting office, permitting you to enlist for this branch of the Service. For such a letter write to Air Transport Command of Army Air Forces, Chief of Communications, 8th Wing, Temporary Building 7, Gravelly Point, Washington, D. C., attention Lieut.-Colonel Harrington, Room 1822.

In the Naval Reserve in Class V-6 as radio technician. If your grade on the Eddy test is sufficiently high, you can obtain a rating as Radioman 2nd Class. Age limits, 17 to 50.

If you really want to get into radio work in the war effort, it is advisable that you enlist in the branch of the Service in which you are most interested. If you are physically fit, and within the age limits, present your radio license at the Recruiting Office. You should be allowed to enlist. If you have any trouble in doing so, wire or write George W. Bailey, 2101 Constitution Ave., N.W., Washington.

"ADVICE TO YOUNG MEN"

You young fellows of the 18–19 group will very possibly wish to volunteer for radio duty in a branch of the service of your own selection — concerning which we have an item elsewhere in this department. If you decide to await your call in the draft, it is very important that you succeed in getting an assignment to radio duties when you are first tested for your capabilities. It used to be generally possible for us to arrange for the transfer to radio work of a good amateur who got a "pile-it" job, but now requests from "outsiders" like us are no longer considered. You have to put everything you've got into your first effort to get radio duty; you can be practically assured of a communications assignment if you do. But it is very important that, when you are called, you take along with you your amateur and commercial licenses and any other documents you have to certify radio ability, such as an ARRL "Proficiency Certificate," AARS certificate, graduation certificates from radio courses, and so on. The reason for this is that early in your military career you will be called before an examining board and tested to determine where you will be most useful. Then is when you will need those documents, particularly that operator license. Whenever you are queried, orally or by questionnaires, we advise you to stick to radio, insist that it has been your main interest in life, describe your operating experience and the number of years you've had a government license, and the number of transmitters that you have built. That'll get you radio duty.

THE Y.L. DEPARTMENT

Here is a list of the opportunities available this month to women whose code and theory ability has earned them amateur operator licenses:

The Civil Aeronautics Administration is running a six months' training course for qualifying women in a position called "Trainee Junior Aircraft Communicator." The pay is $1440 per annum during training and, upon completion of the course, a position in the airways at $1620, with good possibility of further advancement. Further details on page 23, October *QST*. You should apply to Civil Service for admission to the course; details at any first- or second-class post office or Civil Service district office. (Men are still wanted for these jobs, too.)

The Army Air Forces are taking student instructors at $1620, or experienced radio women at $2000, as instructors at four schools: Scott Field, Illinois; Chicago; Sioux City, S. D., and Madison, Wis. Apply to your local Civil Service office. This cancels previous instructions to apply to Knollwood Field.

The Signal Corps General Development Laboratory at Fort Monmouth is in need of many hundreds of women to report about the middle of December to pursue courses in radio, telephone and drafting work. There is a salary of $1440 ($120 a month) during the six months' training period. Thereafter the graduates assume positions as technicians in the Signal Corps laboratories, assisting engineers in design and development work, at higher salaries beginning at $1620. The only requirements for these applicants are that they have high school education, having had

math, science and preferably physics and trig while in school. They should also show an aptitude for mechanical training. No previous radio experience is necessary. Living conditions in surrounding towns are very good, with plenty of furnished rooms at approximately $5 a week. Meals available in the school cafeteria. Books and equipment furnished free. School runs eight hours a day, six days a week. Volunteer classes in code instruction are being organized and every graduate of the school can be well qualified to pass the amateur operator examination. Applications are accepted from citizens in any part of the country, provided they pay their own transportation to Monmouth. In addition to trainees, the Laboratory seeks the services of women qualified to teach radio in the classroom and laboratories. Naturally, this requires more education and radio background. Salaries for these positions range from $2000 to $3200, depending upon qualifications. Applications should be addressed to the Personnel Officer, Signal Corps General Development Laboratory, Fort Monmouth, N. J.

Positions are also available for licensed women amateurs in several branches of the United States Navy, doing work of a more technical nature of considerable importance. You may apply direct to any one of the following offices: (1) Radio Section, Bureau of Ships, Navy Department, Washington, D. C., attention Lt. L. B. Wheeler, Room 2N-21; (2) Naval Ordnance Laboratory, Navy Department, Washington, D. C., attention Mr. Ralph Cautley; (3) Naval Research Laboratory, Anacostia, D. C., attention Mr. Fred A. Pierce, Personnel Procurement Section.

The Radiation Laboratory, Massachusetts Institute of Technology, Cambridge, Mass., also has a few openings for qualified women. Application should be made to the above address, attention Dr. F. W. Loomis.

Radio women may enlist in WAAC and receive the regular basic training. Then if they have high-school education, including physics, and are mechanically inclined, they may be selected from the ranks of WAAC auxiliaries and given the Signal Corps aptitude test. If they pass these requirements they will be given several months of training at the Midland school at Kansas City, under Signal Corps supervision, to prepare them for communications duties. We believe the chief need is for code clerks, telephone switchboard operators, telegraph and radio operators and radio mechanics. Training of the first group starts November 30th and additional groups will be accepted as of December 28th, January 25th and March 1st. Those who pass this course will be assigned positions which release AAF and SC enlisted men for foreign duty. The women in this service will probably be organized into special WAAC Service Command companies. WAAC information from your Army recruiting station.

INSTRUCTORS NEEDED

All over this country there is a rising note of urgency in the call for radio instructors, theory and code and shopwork, chiefly theory. Many amateurs are finding this their niche and the larger schools are full of ham instructors. Items on this subject have appeared in the last three issues of *QST*, to which we refer you for data to supplement the following:

The prodigious schools of the Army Air Forces in Chicago remain in great need of instructors. There are many thousands of students there and many hundreds of teachers are needed. Instructors, depending upon their qualifications, receive $3200, $2600, or $2000. Those who have something on the ball, but aren't quite qualified to instruct, are accepted at $1620 and are themselves given a three months' course in teaching, after which they jump to the $2000 grade of junior instructor. The qualifications for an original appointment as a junior instructor are either a year's experience in technical radio work, six months' schooling in a recognized radio school, a year's engineering study including a course in radio, a defense radio course such as ESMWT, or possession of an amateur operator license. Interested amateurs should write, for further information and application blanks, to Capt. John T. Gilmore, Secretary, AAF Chicago Schools, 720 So. Michigan Blvd., Chicago.

Prefer blue grass? The Lexington Signal Depot also continues to need civilian instructors for its extensive training program, mentioned in our September issue. War Department indefinite appointment; age limits, 20 to 56. Men or women, but male applicants may not be in draft classifications I or II. Again the basic position is known as junior instructor, with a $2000 salary. With successively higher requirements, applicants may qualify as assistant instructor at $2600, associate instructor at $3200, instructor at $3800. Promotion is rapid in this service (whether at Lexington, or at Chicago or any of the other Air Forces' schools).

The commander of the training division at the Kentucky school will be glad to exchange particulars with you. With information on yourself, address Capt. W. Gayle Starnes, Training Division, Lexington Signal Depot, Lexington, Ky.

The high schools of the nation have been asked by the War Department and the U. S. Office of Education to install pre-induction training courses in several technical fields, including electricity, radio theory, operating and mechanics. Everything that a student can be taught before induction saves that much time later. Some high schools are already at work on this program; others will follow by the thousands commencing February 1st. The need for instructors, in both theory and shop work, is going to be unbelievable.

Meanwhile, at many vocational and technical

schools, thousands of Signal Corps civilian employees are receiving instruction in the repair and maintenance of Army communications apparatus. High school or college physics teachers with a minimum of two years' teaching experience are needed to instruct in theory. For instructors in the practical shop program, the basic requirements are for a radio service man with at least five years' experience as such, or a radio amateur with two years' experience under license, and with the ability to teach others. Those knowing the subject, but without teaching experience, can frequently arrange for a free course in that subject itself, through their State Board of Education. These are not Civil Service jobs. The work is done under the ordinary basis of civilian hiring, with quite satisfactory salaries. The instructors generally are employed by local boards of education, and must meet certification requirements which may vary in the several states. But if you are qualified and wish to volunteer your services, and desire further information, you may address the State Director of Vocation Training for War Production Workers, in care of the State Office of Education, at the capital of the state containing the school in which you are interested. You will find both state and local officials much interested in obtaining qualified instructors.

We give below a list of the schools where this Signal Corps training is in process. It will be noted that there are no such courses in Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New Jersey, Michigan, Montana or Nevada. If you live in one of these states, you may address yourself to the state director of a neighboring state. In the following listing by states, the name of the city is frequently indicated by the title of the school, and is shown separately only where necessary to establish the location.

Alabama: State Teachers College, Livingston; University of Alabama, Tuscaloosa; Florence High School; Alabama School of Trades, Gadsden; Murphy High School, Mobile; State Teachers College, Troy.

Arizona: Some school in Phoenix.

Arkansas: Little Rock Trade School.

California: Schools in San Francisco, Los Angeles, San Mateo, San José, Santa Rosa, Berkeley, Oakland, Ventura, Kentfield, Palo Alto, Fresno, Modesto, Santa Maria, Pasadena, Alameda and Santa Ana.

Colorado: Vocational School for Defense Workers, Greeley; public schools of Steamboat Springs; State Junior College, Trinidad; something at Boulder.

Delaware: Wilmington Trade School.

District of Columbia: Chamberlain Vocational School, Washington.

Florida: Lively Vocational School, Tallahassee; Florida Normal & Industrial Institute, St. Augustine; some school at Daytona Beach.

Georgia: Technical High School, Atlanta; Junior College, Atlanta; Dalton High School; Griffin High School; Savannah Vocational School.

Idaho: Some school at Boise.

Illinois: Burr Vocational School, Chicago; Spry Vocational School, Chicago; Bancroft Vocational School, Chicago.

Indiana: School 95, Indianapolis; Crispus Attucks, Indianapolis; Gerstmeyer Technical High School, Terre Haute.

Iowa: West High School, Des Moines.

Kansas: National Defense Training School, Kansas City.

Kentucky: Schools at Ashland, Covington, Harlan, Lexington, Louisville, Madisonville, Owensboro, Paducah, Pointsville, Shelbyville and Somerset.

Louisiana: Shreveport Vocational School.

Maryland: Baltimore High School and Schools 94, 452 and 453, Baltimore; Fort Hill High School, Cumberland.

Massachusetts: Boston Teachers College, Boston Trade School, Medford Vocational School, Springfield Trade School, New Bedford Vocational School, Newton Vocational School, Westfield State Teachers College.

Minnesota: High School, Mankato; East High School, Minneapolis; Dunwoody Institute, Minneapolis.

Mississippi: A & M College, Starkville; Mississippi State College, Starkville.

Missouri: Hadley Technical High School, St. Louis.

Nebraska: Nebraska State Trade School, Milford; Technical High School, Omaha.

New Mexico: Las Vegas High School.

New York: New York City Signal Corps Training School; Paul Smith School, Paul Smith; Troy Vocational School.

North Carolina: Winston-Salem High School.

North Dakota: High School, Grand Forks; North Dakota State School of Science, Wahpeton.

Ohio: Electrical High School, Cincinnati; West High School and Edison Occupational School, Cleveland; Franklyn University, Columbus; some school at Toledo.

Oklahoma: Oklahoma City Trade School.

Oregon: Some schools in Albany, Astoria, Eugene, Oregon City and Salem.

Pennsylvania: Schools in Altoona, Bethlehem, California, Easton, Harrisburg, Hershey, Lancaster, Philadelphia, Pittsburgh, Reading, Stevens and Westport.

South Carolina: Some school at Greenville.

South Dakota: Aberdeen Trade School.

Tennessee: Memphis Vocational School; Hume-Fogg Technical High School, Nashville.

Texas: San Antonio Technical High School; Luther Burbank Vocational School, San Antonio.

Utah: Some school at Logan.

Virginia: Danville Trade School.

Washington: Something at Seattle.

West Virginia: Stonewall Jackson Trade School, Charleston; West Virginia State College, Institute; West Virginia Institute of Technology, Montgomery; some school at Wheeling.

Wisconsin: School of Vocational & Adult Education, Ashland; Milwaukee Vocational School; some school at Janesville.

Wyoming: Laramie High School.

At the moment, code is being taught under this program only in New York City. There is a possibility of its expansion, and persons interested in giving code instruction are also requested to register that fact with the appropriate school.

NAVY U.H.F.

We renew your attention to the Navy's call for Class A and B amateurs to enlist for radiolocator maintenance and operation, as reported on page 41 of November *QST*. It is possible for an amateur who does well in the qualifying examination to be given an initial rating of RT2c, up four ratings over the ordinary original enlistment. As this is technical work, code knowledge is not required. Age limits, 17 to 50. Excellent technical schooling, including special u.h.f. stuff. Details and forms from your Navy recruiting station.

RADAR WORK NEEDS OFFICERS

We again report that the outstanding service opportunity for trained communications engineers and electronic physicists is in radiolocator work. The quest for skilled men continues as the nation's situation becomes more urgent. This service holds the cream of the technical fellows, who are receiving special training and experience with intricate secret microwave devices. Incidentally, these men are pioneering in a new technique which is certain to have a remarkable place in civilian life after the war. Commissions are generally hard to get these days, but they're easily available for the men qualified for radar work. All the arms are looking for candidates.

In the Army, this is the Electronics Training Group of the Signal Corps. Candidates must be graduates of an accredited college, either in science with a major in electronic physics, or in electrical engineering, preferably with emphasis on communications. The age limits are 16 to 46. Second lieutenancy. The equivalent naval officers are ensigns in the branch called Aviation Volunteer (Specialist) and must be EE graduates, or the practical equivalent, between 19 and 50 years of age. This work in the Marine Corps is called the Aircraft Warning Service. While similar technical graduates are desired, in special cases two years of college will do; and in this service there are some appointments for specially-qualified men up to the rank of major. *Correcting previous statements in this department, the age limits for commissioned radar service in the Marine Corps are 20 to 45 years.*

If you are interested in one of these services, write full particulars of yourself to George W. Bailey, Office of Scientific Research & Development, 2101 Constitution Avenue, N.W., Washington, D. C., to obtain fuller information.

VOLUNTEER OFFICER CANDIDATES

Nowadays the Army makes most of its officers by selecting enlisted men and sending them to Officer Candidate Schools. An arrangement of particular interest to married men is set forth in Selective Service Memorandum No. I-394, to all state directors. It provides a method whereby "Registrants between the ages of 18 and 45 who have been, or are entitled to be, deferred from military service solely by reason of dependency, and therefore have been, or are entitled to be, classified in Class III-A, may volunteer at the local board for induction through the Selective Service System in order to compete for selection as an officer candidate in the Army of the United States." Correcting a report made on this subject in October *QST*, note that Class III-B is not included.

A registrant interested in this opportunity must file with his local board a Form 175, "Application to Volunteer and Waiver of Dependency." It must be signed by the registrant and all his dependents over 18 years of age. Next comes a physical examination. If he passes that, he is sent to a reception center or replacement training center for a qualification examination, thereafter returning home. If he is disqualified, the local board will deny his application to volunteer and he will be returned to Class III-A. If he qualifies on this examination, the board will immediately change his classification to I-A and stamp the letters "VOC" on all his documents, the V indicating that he is a volunteer. He is then ordered to report for induction as a volunteer on the next call for men from his local board.

The average period of his basic and officer-candidate training will be from six to nine months, during which time he will receive the same rate of pay as a private inducted into the Army. If he should be disqualified at any time during his training period, or should be found disqualified to receive a commission, he will, at his request, be released from active duty, and returned to his home, and will not again be required to undertake active duty unless and until other men in the same status, with respect to persons dependent upon them for support, are being inducted into military service.

R.O.T.C. DATA FOR COLLEGE STUDENTS

Colleges with compulsory ROTC:

In colleges where the Army basic ROTC course is compulsory for freshmen and sophomores, students who desire to serve in other Services than the Army may so state their choice at the time of their enlistment in the ROTC, and that choice will prevail provided they are not later selected to take the Army ROTC advanced course. When an enlistee who has chosen to serve in a Service other than the Army becomes eligible, at the end of the sophomore year, for enlistment in the Service of his stated choice, he will be discharged from the Army Reserve. His discharge papers will be forwarded by the Army Command authorized to effect discharge, and will be designated to the Navy or Marine Corps officer authorized to effect enlistments.

Noncompulsory Army ROTC only:

Students may enlist in the Naval Reserve or Marine Corps Reserve any time after the ROTC selection has been made from the freshman class.

Noncompulsory Navy ROTC only:

Students may enlist in the Enlisted Reserve of the Army or in the Marine Corps Reserve after selection has been made from the freshman class.

Colleges with no ROTC:

Any student can enlist at any time in any Service, provided the quota is not filled, but he cannot be assigned to a particular branch of the Service he has selected until his junior year. In colleges where there is no ROTC, military training is not compulsory.

(Continued on page 114)

How's Your Math?

A Brief Review of Some Fundamental Operations

BY DAWKINS ESPY,* W6UBT

There's no real need to be frightened away from articles which introduce such outlandish expressions as *cos, sin* and *log* and use marks apparently unrelated to ordinary punctuation. Mathematical symbols are not used to confuse the uninitiated but to give compact and precise expression to ideas which often would be pretty long-winded and confusing when expounded in "plain" English. Here's a chance to get a little initiation.

THE increasing importance of the amateur to the war effort makes it highly desirable for him to understand some of the fundamentals of mathematics, since mathematical relationships will be encountered sooner or later in practically every kind of technical work. Obviously this article cannot attempt to present a complete summarization of all types of mathematics used in radio. Rather, it is the intention to treat simply a few of the more common processes.

Mathematics is merely a shorthand way of expressing relationships so that they may be manipulated more easily. It is not unusual to find an equation or relation such as

$$y = ax + b$$

where x and y are the related quantities and a and b are constants. The constants may be very simple or very complex, but the mathematician does not allow himself to become confused by the complexity of the involved quantities. What he wants is an explicit and simple relationship between the variables x and y. Soon he arrives at an ordinary equation such as that given above, and examination of the quantities — as by plotting a graph or making a table of values — enables him to get a mental picture of their relationship.

Simplicity is the essence of mathematics.

Equations

An equation is simply a statement that the two quantities on the opposite sides of the "equals mark" are identical, e.g.:

$$A = B$$

*Columbia University, Division of War Research, New London, Conn.

If this is true B can be replaced by its equal A and the equation becomes

$$A = A$$

which we know is true.

Four important properties of equations are:

(1) Both sides of the equation can be multiplied by the same number without changing the equality.

(2) Both sides of the equation can be divided by the same number without changing the equality.

(3) The same number may be added to both sides of the equation without changing its equality.

(4) The same number may be subtracted from both sides of the equation without changing the equality.

To illustrate these principles, consider the equation

$$6 = 4 + 2 \qquad \text{(check } 6 = 6)$$

multiplying both sides by 2

$$12 = (4 + 2)\,2$$
$$12 = 8 + 4 \qquad \text{(check } 12 = 12)$$

dividing both sides by 4

$$3 = \frac{8 + 4}{4} = 2 + 1 \quad \text{(check } 3 = 3)$$

adding 3 to both sides

$$3 + 3 = 2 + 1 + 3 \text{ (check } 6 = 6)$$

subtracting 4 from both sides

$$3 + 3 - 4 = 2 + 1 + 3 - 4 \quad \text{(check } 2 = 2)$$

Thus, the equality of the equation was maintained at every step.

Many amateurs have wondered at the various forms that Ohm's Law takes on. By using the first two rules outlined and choosing the proper quantities by which to multiply and divide, the various relations can be shown to be consistent.

A familiar form of Ohm's Law is

$$E = IR$$

by dividing both sides by I we have

$$\frac{E}{I} = \frac{IR}{I}$$

or, since I divided by I is equal to 1,

$$\frac{E}{I} = R$$

Reverting back to the original form

$$E = IR$$

and dividing both sides by R, we get

$$\frac{E}{R} = I$$

Note that dividing by R is the same as multiplying by $\frac{1}{R}$, so that either Rule (1) or Rule (2) could have been used to perform the operation. The quantity $\frac{1}{R}$ is known as the *reciprocal* of R.

Considering the power form of Ohm's Law, and recalling the form most familiar to the amateur, the one used to compute power input:

$$P = EI$$

Replacing E by its equivalent IR we have,

$$P = IRI$$

or

$$P = I^2R$$

and substituting for I its equivalent $\frac{E}{R}$ we have,

$$P = \left(\frac{E}{R}\right)^2 R$$

$$P = \frac{E^2}{R^2} \times R$$

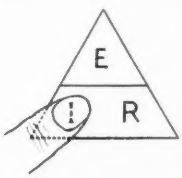
noting that $R^2 = R \times R$

$$P = \frac{E^2 \times R}{R \times R}$$

$$P = \frac{E^2}{R}$$

Incidentally, a good helper to assist in remembering Ohm's Law is the triangle shown in Fig. 1. By placing a finger over the desired quantity, the quantities left give the proper formula. For example, if one wishes to know the current I, covering it up leaves $\frac{E}{R}$ which we've shown to be a valid form of Ohm's Law.

Fig. 1



Extracting Square Root

The problem of finding the square root of a number occurs frequently, and it is surprising how many of us have forgotten the method that we learned in high-school arithmetic. Though the procedure given here is somewhat different and is

TABLE I

Squares of numbers from 1 to 100

n	n^2	n	n^2
1	1	51	2,601
2	4	52	2,704
3	9	53	2,809
4	16	54	2,916
5	25	55	3,025
6	36	56	3,136
7	49	57	3,249
8	64	58	3,364
9	81	59	3,481
10	100	60	3,600
11	121	61	3,721
12	144	62	3,844
13	169	63	3,969
14	196	64	4,096
15	225	65	4,225
16	256	66	4,356
17	289	67	4,489
18	324	68	4,624
19	361	69	4,761
20	400	70	4,900
21	441	71	5,041
22	484	72	5,184
23	529	73	5,329
24	576	74	5,476
25	625	75	5,625
26	676	76	5,776
27	729	77	5,929
28	784	78	6,084
29	841	79	6,241
30	900	80	6,400
31	961	81	6,561
32	1,024	82	6,724
33	1,089	83	6,889
34	1,156	84	7,056
35	1,225	85	7,225
36	1,296	86	7,396
37	1,369	87	7,569
38	1,444	88	7,744
39	1,521	89	7,921
40	1,600	90	8,100
41	1,681	91	8,281
42	1,764	92	8,464
43	1,849	93	8,649
44	1,936	94	8,836
45	2,025	95	9,025
46	2,116	96	9,216
47	2,209	97	9,409
48	2,304	98	9,604
49	2,401	99	9,801
50	2,500	100	10,000

actually an approximation, it is quite accurate enough for most purposes and is certainly a simplification over the old method.

If n^2 is the number whose square root is sought, and a^2 is the nearest perfect square, as given in Table I, to n^2, then b, the third quantity involved in this method, is given by the equation

$$b = \frac{n^2 - a^2}{2a}$$

By choosing the proper value for a^2 and determining b from the above formula, we can find n, the desired square root, from the formula

$$n = a + b$$

All the squares given in Table I are what are known as perfect squares; that is, each is the square of some whole number such as 1, 2, 3, 4,

etc. The square of 2.5 would not be a perfect square.

Suppose we should like to find the square root of 372. By referring to Table I we see that the nearest perfect square is 361, the square root of which is 19. Thus, in our method $a = 19$ and $a^2 = 361$. Now, to find b we substitute in the formula given above

$$b = \frac{n^2 - a^2}{2a} = \frac{372 - 361}{2 \times 19} = \frac{11}{38} = 0.289$$

Thus, the square root of 372 equals $a + b = 19 + 0.289 = 19.289$.

Suppose the number does not appear in the table; for example, $n^2 = 78{,}921$. By moving the decimal point successively to the left we can cause the number to come within the range of our table twice, first as $n^2 = 7892.1$ ($a = 88$, $a^2 = 7744$) and secondly as $n^2 = 789.21$ ($a = 28$, $a^2 = 784$). The rule is: Move the decimal point to the left two places at a time, and use the largest a^2 within the range of the table that is obtainable by this method. In our example this would indicate the use of $a^2 = 784$, $a = 28$. Now add ciphers to a^2 until the total number of digits is the same as in the original number, n^2, and add *half* that many ciphers to a. This gives us $a^2 = 78400$ and $a = 280$; in other words, $\sqrt{78400} = 280$.

Now determine b:

$$b = \frac{n^2 - a^2}{2a} = \frac{78921 - 78400}{2 \times 280} = \frac{521}{560} = 0.87$$

Thus, $n = a + b = 280 + 0.87 = 280.87$.

If the number in the first example had been 392 instead of 372, then the nearest perfect square would be $a^2 = 400$, $a = 20$, and

$$b = \frac{n^2 - a^2}{2a} = \frac{392 - 400}{2 \times 20} = \frac{-8}{40} = -0.2$$

and

$$n = a + b = 20 + (-0.2) = 20 - 0.2 = 19.8.$$

A common radio problem involving square root is the calculation of the turns ratio of a transformer when its impedance ratio is known; in this case

$$\frac{N_p}{N_s} = \sqrt{\frac{Z_p}{Z_s}}$$

Trigonometry

Trigonometry is a method of expressing the relations between the sides and angles of a triangle so that calculations may be simplified. While at first glance there might seem to be no obvious connection between a triangle and radio, it is a fact that trigonometric methods are extremely useful in the practical measurement of distance, height, etc., and that the oscillations of radio waves, alternating currents and the like are closely related to certain properties of triangles.

Everyone "knows" what an angle is, but it is worth our while to define angle from the trigonometric standpoint. An angle is considered to be "generated" by the rotation of a line about a fixed point on which one end of the line terminates, the size of the angle being measured with reference to a second fixed line. For example, the complete rotation of a spoke about the axle of a wheel so that it returns to its original position constitutes a 360° rotation. For convenience, a diagram can be drawn representing this rotation divided into fourths. Each of these fourths or quarters consists of ¼ × 360° or 90° and is called a *quadrant*. The quadrants are designated in a counterclockwise direction as the first, second, third, and fourth, as shown in Fig. 2. Fig. 2 also shows the construction of a right-angled triangle in each of the four quadrants. When constructing such triangles, one side adjacent to the right angle is always made coincident with the horizontal axis, but the vertical, or other side adjacent to the right angle, does not in general coincide with the vertical axis. This causes one of the variable angles always to have its apex at the intersection of the horizontal and vertical axes.

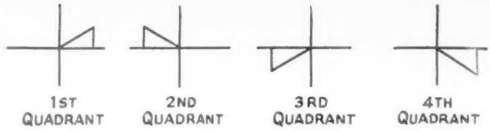


Fig. 2

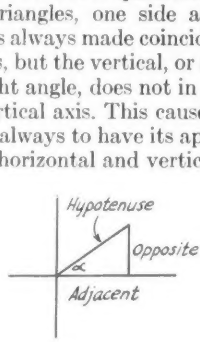


Fig. 3

Suppose we have an angle α (the Greek letters α (alpha), β (beta), and θ (theta) are most frequently used to represent the angles) in the first quadrant, as shown in Fig. 3. The longest side of a right triangle is always known as the *hypotenuse*, the side opposite the angle under consideration is known as the *opposite* side, and the third side is known as the *adjacent* side. This is illustrated in Fig. 3. We can now define the three most important and fundamental *trigonometric functions*, the *sine*, the *cosine*, and the *tangent*, commonly abbreviated as sin, cos, and tan.

$$\sin \alpha = \frac{\text{opp}}{\text{hyp}} \qquad \cos \alpha = \frac{\text{adj}}{\text{hyp}} \qquad \tan \alpha = \frac{\text{opp}}{\text{adj}}$$

Two Fundamental Relations

1. Dividing $\sin \alpha$ by $\cos \alpha$

$$\frac{\sin \alpha}{\cos \alpha} = \frac{\dfrac{\text{opp}}{\text{hyp}}}{\dfrac{\text{adj}}{\text{hyp}}} = \frac{\text{opp}}{\text{adj}} = \tan \alpha$$

Thus

$$\frac{\sin \alpha}{\cos \alpha} = \tan \alpha$$

2. Remember the old rule from plane geometry that the square of the length of the hypotenuse of a right triangle is equal to the sum of the squares of the lengths of the other two sides? Well, here's a use for it. Applying the rule to the triangle in Fig. 3, we have

$$\overline{\text{opp}}^{\,2} + \text{adj}^{\,2} = \text{hyp}^{\,2}$$

now dividing through by hyp ^{2}

$$\left(\frac{\text{opp}}{\text{hyp}}\right)^2 + \left(\frac{\text{adj}}{\text{hyp}}\right)^2 = \left(\frac{\text{hyp}}{\text{hyp}}\right)^2$$

but $\left(\frac{\text{hyp}}{\text{hyp}}\right)^2$ is 1^2 which is just 1 and so

$$\left(\frac{\text{opp}}{\text{hyp}}\right)^2 + \left(\frac{\text{adj}}{\text{hyp}}\right)^2 = 1$$

and substituting the trigonometric values for the left-hand terms, we have

$$\sin^2 \alpha + \cos^2 \alpha = 1$$

The exponent is written after the sin and cos instead of after the angle, as one might be tempted to write it. This is because it is the sin or cos that is squared and not the angle α, as writing it the other way would indicate.

Range of Values

Now that we have a general idea of the form of the important trigonometric relations, the range of values of the sine, cosine and tangent should be examined.

The sine is the ratio of the opposite side to the hypotenuse. Referring to Fig. 4 (b) we see that as the angle α is made large the length of the opposite side approaches the length of the hypotenuse. If the limiting case where α is made 90° is considered, the sides would coincide and the ratio would be 1 to 1, so the sine would have a value of 1 for α equal to 90°. On the other hand, referring to Fig. 4 (c), we see that as α gets smaller and is made to approach zero, the ratio of opposite to hypotenuse approaches zero. Thus, at $\alpha = 0°$, $\sin \alpha = 0$.

For the cosine, we find just the opposite occurring; as α approaches 90° the ratio approaches zero and as α approaches 0° the cosine approaches

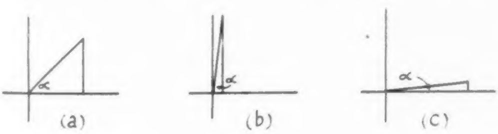


Fig. 4

TABLE II

Trigonometric Functions

Degrees	*Sin*	*Cos*	*Tan*
0°	.000	1.000	.000
2°	.035	.999	.035
4°	.070	.998	.070
6°	.105	.995	.105
8°	.139	.990	.141
10°	.174	.985	.176
12°	.208	.978	.213
14°	.242	.970	.249
16°	.276	.961	.287
18°	.309	.951	.325
20°	.342	.940	.364
22°	.375	.927	.404
24°	.407	.914	.445
26°	.438	.899	.488
28°	.470	.883	.532
30°	.500	.866	.577
32°	.530	.848	.625
34°	.559	.829	.675
36°	.588	.809	.727
38°	.616	.788	.781
40°	.643	.766	.839
42°	.669	.743	.900
44°	.695	.719	.966
46°	.719	.695	1.04
48°	.743	.669	1.11
50°	.766	.643	1.19
52°	.788	.616	1.28
54°	.809	.588	1.38
56°	.829	.559	1.48
58°	.848	.530	1.60
60°	.866	.500	1.73
62°	.883	.470	1.88
64°	.899	.438	2.05
66°	.914	.407	2.25
68°	.927	.375	2.48
70°	.940	.342	2.75
72°	.951	.309	3.08
74°	.961	.276	3.49
76°	.970	.242	4.01
78°	.978	.208	4.70
80°	.985	.174	5.67
82°	.990	.139	7.12
84°	.995	.105	9.51
86°	.998	.070	14.30
88°	.999	.035	28.64
90°	1.000	.000	0.00

1. Thus for $\alpha = 90°$, $\cos \alpha = 0$ and for $\alpha = 0°$, $\cos \alpha = 1$. These relations can also be seen by referring to Fig. 4.

The tangent, according to derivation 1, is equal to the ratio of sin to cos. For $\alpha = 90°$, $\sin \alpha = 1$ and $\cos \alpha = 0$ and thus $\tan \alpha = \frac{1}{0}$, which is infinitely large. At $\alpha = 0°$, $\sin \alpha = 0$ and $\cos \alpha = 1$, so $\tan \alpha = \frac{0}{1} = 0$. Thus the tangent varies from zero at 0° to infinity at 90°.

That $\tan \alpha = \infty$ (symbol for infinity) at $\alpha = 90°$ can perhaps be seen more clearly by referring to Fig. 4 (b) again. The tangent is equal to the ratio of the opposite side to the adjacent side, and thus as the angle α approaches 90°, the opposite side approaches the length of the hypotenuse and the length of the adjacent side approaches zero. Therefore the ratio keeps getting

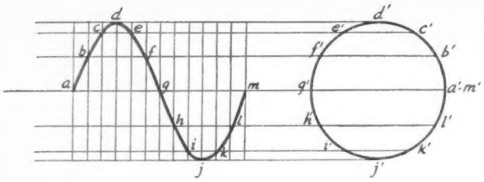


Fig. 5

larger and larger. Consider the ratio of $\frac{100}{x}$; if $x = 50$, the ratio is 2; if $x = 10$, the ratio is 10; if $x = 1$, the ratio is 100; if $x = 0.5$, the ratio is 200, etc. Thus as x gets smaller and smaller, approaching zero, the ratio gets progressively larger. Such a ratio is said to be infinite or equal to infinity at $x = 0$.

The sine, cosine and tangent relations are known as "circular functions" since their physical properties are connected with the circle. The construction given in Fig. 5 shows how a sine wave can be constructed from a circle and how the intermediate values between 0° and 90° may be obtained. Corresponding points in the construction are lettered a and a′, b and b′, etc.

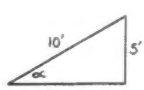
Table II gives a chart of sine, cosine and tangent values for every 2°. This should be sufficient for a number of uses. Standard textbooks and handbooks have more complete tables.

Examples

Ex. 1. The opposite side of a right triangle is 5 feet long and the hypotenuse is 10 feet. Find the value of the angle α.

$$\frac{\text{opp}}{\text{hyp}} = \sin\alpha = \frac{5}{10} = 0.5$$

$$\alpha = 30^\circ$$



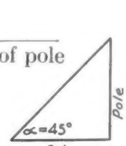
Ex. 2. An observer is 30 feet away from an antenna pole and from his position there is an angle of 45° between the bottom and top of the pole. Determine the height of the pole.

$$\tan\alpha = \frac{\text{opp}}{\text{adj}} = \frac{\text{pole height}}{\text{distance to bottom of pole}}$$

$$\tan\alpha \times \text{dist. to pole} = \text{pole height}$$

$$\tan 45^\circ \times 30 \text{ ft.} = \text{pole height}$$

$$\text{pole height} = 30 \text{ ft.}$$



Thus a rule may be formed: If one sights an angle of 45° between the ground and the top of a pole and the ground is level, the distance from the observer to the bottom of the pole is equal to the pole height.

Logarithms

The logarithm of a number is the power to which a second number, called the *base*, must be raised in order to produce the given number. Sounds complicated? Well, let's see. The definition speaks of a number, any number; let's choose 100 for argument's sake. It also mentions a base; that, too, may be any number[1] but for simplicity 10 is usually used. All right, we've got to raise the base to a power to get the number, but since the quantities are interrelated, the fixing of any two of the three quantities involved automatically fixes the third. If you square a number, that's called "raising the number to the second power." Raising a number to any power means multiplying the number by itself that many times. Well, 10^2 equals 100, so if 10 is the base and 100 is the number, then 2 is the logarithm. Or the log (abbreviation for logarithm) to the base 10 of 100 is 2. Written mathematically

$$\log_{10} 100 = 2$$

This is read "log to the base 10 of 100 equals 2." We may also write

$$\log_{10} 10 = 1$$

because 10 raised to the 1st power gives 10, and

$$\log_{10} 1.0 = 0$$

Since any number raised to the zero power is 1, 10 raised to the zero power is 1.

[1] 1 cannot be used as a base because as it is raised to various powers the resultant is always 1.

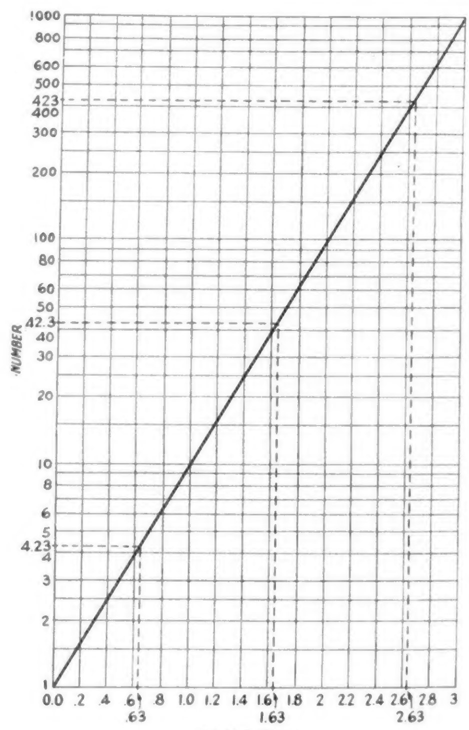


Fig. 6

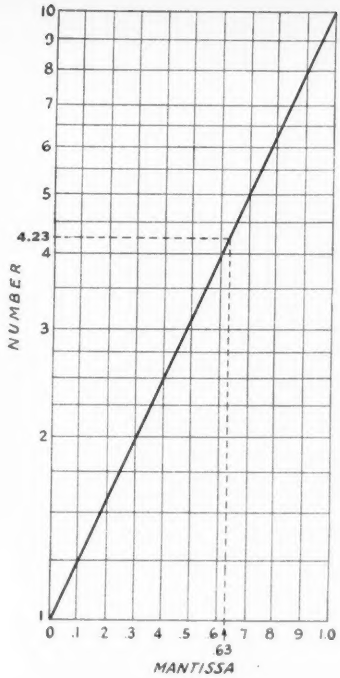


Fig. 7

We can form a table of relations. Since:

Table A

$10^0 = 1$ $\qquad$ $10^{-1} = \frac{1}{10} = 0.1$

$10^1 = 10$ $\qquad$ $10^{-2} = \frac{1}{100} = 0.01$

$10^2 = 100$

$10^3 = 1{,}000$ $\qquad$ $10^{-3} = \frac{1}{1{,}000} = 0.001$

$10^4 = 10{,}000$ $\qquad$ $10^{-4} = \frac{1}{10{,}000} = 0.0001$

$10^5 = 100{,}000$ $\qquad$ $10^{-5} = \frac{1}{100{,}000} = 0.00001$

$10^6 = 1{,}000{,}000$ $\qquad$ $10^{-6} = \frac{1}{1{,}000{,}000} = 0.000001$

then:

Table B

$\log_{10} 1 = 0$

$\log_{10} 10 = 1$ $\qquad$ $\log_{10} 0.1 = -1$

$\log_{10} 100 = 2$ $\qquad$ $\log_{10} 0.01 = -2$

$\log_{10} 1000 = 3$ $\qquad$ $\log_{10} 0.001 = -3$

$\log_{10} 10{,}000 = 4$ $\qquad$ $\log_{10} 0.0001 = -4$

$\log_{10} 100{,}000 = 5$ $\qquad$ $\log_{10} 0.00001 = -5$

$\log_{10} 1{,}000{,}000 = 6$ $\qquad$ $\log_{10} 0.000001 = -6$

Now it becomes obvious that, if we desire to determine the log of just any number, we will have to have some intermediate values. If, for example, we want the log of 423, we know that it will lie between 2 and 3 since 2 is the log of 100 and 3 is the log of 1000. We can determine the log of 423 by plotting on semilogarithmic paper some of the values given in Table B above, and drawing a smooth curve through the resulting points. Such a curve is shown in Fig. 6. Referring to this curve, we find that the log of 423 is 2.63. Upon further examination of Fig. 6 we find that the log of 42.3 is 1.63 and the log of 4.23 is 0.63. In other words the fraction, or part to the right of the decimal point — the "mantissa," as it is called — is the same if the number is made up of a fixed group of digits regardless of the position of the decimal point. The portion of the logarithm to the left of the decimal point is known as the "characteristic" and is the only part of the log that varies as one shifts the decimal point about.

Fig. 7 shows a portion of Fig. 6 enlarged so that it may be used to determine the mantissa of any number. A simple rule may be formed to find the characteristic of any number: The characteristic is one less than the number of digits to the left of the decimal point for a number greater than 1, and is a negative number equal to one more than the number of ciphers between the decimal point the actual beginning of the number for a number less than 1. This rule can be verified by referring back to Tables A and B above.

If greater accuracy than can be obtained from Fig. 7 is desired, the log tables found in many texts and reference books may be used. The tables in every case consist of a list of mantissa values.

Many problems require the examination of the antilog. This is the inverse operation to finding the log. In other words, you are given a log and you are to find a number to correspond. The antilog of 3.26 is 1820, for example.

Now that we understand the manipulation of logarithms let's turn to some of their practical uses. Logarithms may be used to multiply, divide, raise to powers, and extract roots. To multiply two numbers their logs are added and the antilog of the sum taken. To divide one number by another, the log of the denominator is subtracted from the log of the numerator and the antilog taken. To raise a number to a power, the log of

(Continued on page 84)

TABLE III

Use of Logarithms

Operation	*Method*
To multiply numbers	add their logarithms
To divide numbers	subtract their logs
To raise to a power	multiply the log of the number by the power
To extract root	divide the log of the number by the root

HAPPENINGS OF THE MONTH

YOUR MILLIAMMETERS DESPERATELY NEEDED

THOUSANDS of milliammeters are acutely needed by the Signal Corps, in a critical situation that has arisen in connection with the production of other radio apparatus. The need is most urgent.

As announced in this column last month, the League, to save the Signal Corps the need to negotiate a formal contract with every selling amateur, is acting as informal purchasing agent, and will purchase and pay for meters on behalf of the Signal Corps, and turn them over as fast as they can be collected.

On behalf of the Army, we will pay $3.00 for every d.c. milliammeter of up to 500 ma. full scale which is sent in to us, of whatever make, the amateur list price of which exceeds $3.00 and which is accepted by the Signal Corps. Low values, 0–10, are particularly needed, but we'll take everything up to 0–500. Those not accepted will be returned. Not only are meters wanted in good working condition, but the same amount will be paid for milliammeters which are burnt-out but otherwise OK — but movement, glass, scale and pointer must be OK. *Only d.c. milliammeters,* and only those for which you had to pay $3.00 or more when new.

Although November *QST* has been in circulation only a few days as we write, the Signal Corps (and we as well) are gratified at the response amateurs have already made. But it is not nearly enough — thousands more are needed. Knowing this to be a case of dire necessity, as we do, we appeal to all you readers to disconnect your milliammeters and send them in to ARRL. Your good ones as well as your duds, since this is for an urgent Army need. That isn't much money to offer you for a meter that may have cost $9.00, but you are asked, in the name of patriotism, and because of the situation, to accept a flat average price of $3.00 for all meters, good and bad, which are accepted. If we win this war, there will be plenty of milliammeters when we go back on the air, and if we don't win it you won't need them. So come on with them at once!

Pack carefully in shock-absorbing material, mark package "Meters," be sure to show your name and your own complete mail address clearly, prepay charges, ship any way you like, to ARRL, 38 LaSalle Road, West Hartford, Conn.

Note: D.c. voltmeters, *1000-ohm-per-volt type only* i. e., with 0-1 ma. d.c. movement, any range, up to 4-inch dial scale, will be accepted if they meet other specifications as stated.

ELECTION NOTICE

To all members of the Northwestern and Rocky Mountain Divisions:

YOU are hereby advised that no eligible candidate for alternate director has been nominated from your divisions under the recent call. By-law 21 provides that if no eligible nominee be named, the procedure of soliciting and nominating is to be repeated. Pursuant to that By-law, you are again solicited to name a member of your division as a candidate for alternate director. See the original solicitation published at page 28 of September *QST* and page 37 of October *QST*, which remains in full effect except as to dates mentioned therein: nominations must now be filed at the headquarters office of the League, in West Hartford, Conn., by noon, EWT, of the 20th day of January, 1943. Voting will take place between February 1st and March 20th, 1943, on ballots to be mailed from the headquarters office the first week of February. The new alternates will take office as quickly as the results of the election can be determined after March 20, 1943, and will serve for the remainder of the 1943–1944 term.

You are urged to take the initiative and file nominations.

For the Board of Directors:

K. B. WARNER
Secretary

November 2, 1942.

ELECTION RESULTS

ALTHOUGH balloting is going on in the Hudson Division for both director and alternate, in the Central and Roanoke for director and in the New England Division for alternate, there were several instances where the incumbent director or alternate was the only eligible nominee. In those cases, he has been declared reëlected for the 1943–44 term without the need for balloting by the membership.

This was the case with the New England Division's director, Percy C. Noble, W1BVR; the Northwestern's Karl W. Weingarten, W7BG; and the Rocky Mountain's C. Raymond Stedman, W9CAA. In the Southwestern Division it applied both to Director John E. Bickel, W6BKY, and his alternate, E. E. Wyatt, jr., W6ARW. It was also the case with the alternate from the Roanoke Division, J. Frank Key, W3ZA.

The Central Division named three candidates for alternate director: Everett H. Gibbs, W8AQ; Herbert L. Green, W9ARI; and George W. Hem-

minger, W8VDR. The latter two were found disqualified for lack of the required length of license period and of membership in the League, leaving Mr. Gibbs as the only eligible candidate. Pursuant to our by-laws he was therefore declared elected for the forthcoming term, without the necessity for balloting. For many years our SCM for Ohio, and president of the Medina County Radio Club, Mr. Gibbs has been continuously active in amateur radio since 1920. He is a development engineer for Seiberling Rubber Company at Akron, lives in nearby Wadsworth.

The Northwestern and Rocky Mountain Divisions failed to name an eligible candidate for alternate director and are being solicited above for fresh nominations, with elections delayed until March. In the other divisions the results will be apparent on December 20th, the new terms to begin January 1st.

STAFF NOTES

We thought that John Huntoon, W1LVQ, was going to be spared to the headquarters' staff to run WERS during the war, but Unc finally decided otherwise. So now it's Chief Radioman John Huntoon, U. S. Coast Guard Reserve, instructor in the CG school at Atlantic City — on leave of absence for the duration.

JOHN HUNTOON

Huntoon came to headquarters four years ago to become an assistant secretary of the League. As W9KJY he had been very active in Chicago club affairs, and was for years our SCM for Illinois. In May of this year the Board of Directors appointed him to act also as communications manager during the absence of Lieut.-Colonel F. E. Handy. He has done a bang-up job of organizing WERS and his many *QST* articles on that subject have laid the groundwork excellently. He is one of the best operators in the country, possessed of a renowned fist and the holder of several speed trophies. He has had considerable teaching experience and we're reminded to mention that he is the author of the League's recent booklet on *Learning the Radiotelegraph Code.* He is also a student of cryptanalysis and authored a series of elementary articles on that subject in *QST*. It looks as though the Coast Guard has picked up another pretty good man!

George Hart, W1NJM, the assistant communications manager, has taken over in the Communications Department. Charles A. Service, jr., W4IE, is now senior assistant secretary.

TUBES WANTED

The National Association of Broadcasters reports that some broadcasting stations anticipate difficulty in obtaining transmitting tubes, as a result of which they are desirous of compiling a list of amateurs who are willing to sell tubes suitable for use in broadcast transmitters. It is their intention to make such data available to broadcasters and let them purchase the tubes directly from amateurs. (We do not yet register tubes in the ARRL ApBu.) It is of course apparent that every time a ham tube goes to work in a b.c. station a new tube is spared for military use.

Amateurs who care to offer their power bottles for sale will please address the National Association of Broadcasters, attention Howard S. Frazier, Director of Engineering, 1626 K Street, N.W., Washington, D. C., listing the type, age, and price desired, and giving all pertinent information as to condition. You are then likely to hear soon from a broadcast station that wants to buy.

Remember that 958 acorn which came out not so long before we were closed down? They are hard to get, and we know where a few are badly needed for a defense research project. If you will sell one or more, please communicate direct with Dr. Harold P. Donle, 8 Jackson St., Meriden, Conn. (telephone Meriden 642-J1).

MAINTAINING AMATEUR STATUS

In view of the facts that amateur station and operator licenses are issued jointly, that an operator must have his license in his possession whenever operating, and the FCC will not reissue station licenses but does require renewal and modification applications for stations to be filed if one is to "maintain amateur status," the question has come up whether the Commission will require an amateur to submit his old licenses when filing such an application. The answer is yes; FCC is continuing its policy which requires an amateur to submit both operator and station licenses when applying for renewal or modification of either. Where the application relates only to the operator license, a new and separate operator card is issued and the operator side of the original joint station-and-operator license is cancelled. But the station-license side is not canceled and it is returned to the amateur, along with the new operator ticket. Where the application relates to the station license, it will be stamped "Order 87-B applies," to protect the applicant's status, and will be filed by FCC without action, but in such cases the new operator license and the unexpired station license will be returned to the licensee.

OPERATOR LICENSES STILL AVAILABLE

We find that there is still confusion in the minds of some amateurs and would-be amateurs about licenses. While it is true that amateur sta-

tion licenses are no longer issued or renewed, there is no change whatever in the matter of operator licenses. If you are a new candidate for a ham ticket, you may still take the examination in the usual way and will get your license if you pass. If you are already an amateur, you may renew or modify that operator license in precisely the fashion that has been in effect the past ten years. Moreover, it's your duty to keep your operator license in effect — there are innumerable reasons why it will be valuable to you. Just because you read that station licenses are not renewed, don't let your operator license expire. Help us to spread the news that operator licenses are still issued, renewed and modified in the usual manner.

ANTENNA STILL UP?

THE more we think of antennas the more we are inclined to conclude that keeping them in the air is just a liability these days. Some of us may have listening assignments that require the directive pattern of a real antenna, but most of us have nothing to do that can't be done with the short wire we use for break-in. To maintain our antenna systems is going to require more time and materials and money than we can give them under war conditions, so that many of them will be falling down and creating hazards. Nor can we quite escape the fact that the presence of a palpable transmitting antenna gives too much opportunity for speculation as to why it is still there when there is no proper use for it.

These factors combine to make us suggest that we take down our transmitting antennas — now, before the dirty weather of winter sets in.

Having taken yours down, what do you do? You "Get in the Scrap" by giving that copper to the campaign in your community, or by donating it to your favorite charity — which will know where to turn it in. Pure electrolytic copper is scarcer than silver and almost as precious as milliammeters! You don't need it now, and the nation's factories do. It will be made into something that carries a message more important than a radiogram.

REPAIR SERVICE NEEDED

IT IS estimated that in the average large city several hundred broadcast receivers daily go on the blink. With service men being called into the armed forces, or attracted to more lucrative employment, the repair of receivers has become quite a problem. Many dealers have been obliged to discontinue their service departments. And all this at a time when a broadcast receiver in the home is more valuable than ever. Here is a chance for the younger hams of 15, 16 and 17 years to get into the service field. There are plenty of jobs for you now! It is important to keep the broadcast receivers of America working, and at the same time you'll be getting experience which is invaluable training for the many kinds of radio jobs and instructorships which will be begging for your services when you are 18. Look around a little; your local dealer probably has a job for you after school hours and on Saturdays; or, if you're really pretty good, perhaps you can start a neighborhood business of your own.

ARE YOU LICENSED?

When joining the League or renewing your membership, it is important that you show whether you have an amateur license, either station or operator. Please state your call and/or the class of operator license held, that we may verify your classification.

WE REMIND YOU:

IF YOU'RE available for any kind of radio employment, please register with the ARRL Personnel Bureau, after the style of the form appearing on page 38 of October *QST*.

If you're willing to sell your factory-built transmitter or receiver, please register them with the ARRL Apparatus Bureau. Write us for a form, or see August or April *QST* — or just write us.

Amateurs in the armed services are invited to advise us their rank, branch, arm of service, and old home town call — both for themselves and their buddies — so that a personal mention may be made "In The Services" and so that we may compile at headquarters a record of the amateur's service in the war.

BROADCAST OPERATORS NEEDED

SPEAKING of spare time or improved radio jobs for stay-at-home amateurs, it may be seen from occasional advertisements in *QST* that there is quite a shortage of engineers for broadcasting stations, both for control rooms and at transmitters. To keep the stations going, FCC has several times relaxed the operator requirements, but still the shortage continues. Amateurs possessing first- or second-class 'phone licenses qualify quickly for such jobs, after brief training, and sometimes may make arrangements for a short-shift job that permits them to continue their present employment. In several cities the broadcasting stations or the operators' unions are running free instruction courses to train amateurs who have only ham tickets to qualify. If you are interested, make inquiry of a local station and keep an eye out in *QST* for notices.

MISSING IN ACTION

Frank R. Bartosik, RM2c, W8QCR, of Monessen, Pa., has been reported missing in action.

A 25-Watt 2½-Meter M.O.P.A.

Linear Tanks in a Simple Transmitter of Improved Stability

BY JOHN A. BAILEY,* W8UJB

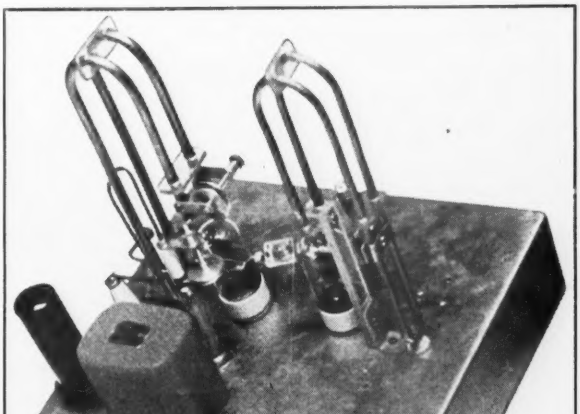
While present regulations covering the frequency stability of WERS installations apply to the carrier only and do not restrict frequency modulation, this does not mean, of course, that the elimination or reduction of frequency modulation is not highly desirable when material is available for the construction of units more elaborate than the usual modulated oscillator. This may be especially important in urban areas where the operation of many stations within a small area may be required. Compactness and portability are not of prime importance in key stations with more or less permanent installations. Frequency modulation may be reduced considerably, of course, by the use of an oscillator-amplifier combination. In addition, the amplifier reduces carrier-frequency changes caused by antenna movement. Another advantage is that the amplifier may be designed for maximum efficiency without regard for frequency stability.

Because the complications and material requirements of a crystal-controlled transmitter for 2½ practically eliminate this type of rig from consideration in these days of scarcity, the simpler combination of a self-excited oscillator and an amplifier appeared to have the most encouraging prospects. Since there has been relatively little material published on oscillator-amplifiers for 2½ meters, several designs were tried before an entirely satisfactory arrangement was obtained. Seeking stability, the high-C tank recently described in *QST* [1] was tried with capacity coupling to the amplifier. HY75s were used in both oscillator and amplifier. With this arrangement, it was impossible to secure more than 2 milliamperes rectified current in the amplifier grid circuit, while the oscillator insisted on overheating. A tank with more inductance was substituted for the high-C oscillator tank and, although the amplifier grid current increased to about 5 ma., the frequency stability of the oscillator was very poor. Linear tanks were then tried with marked improvement. The final model is shown in the photographs and the circuit diagram appears in Fig. 1.

The oscillator circuit is of the simple shunt-fed ultraudion variety with a linear tank, connected between grid and plate, replacing the usual L/C tank. High voltage is fed in at the center of the line through the r.f. choke. The frequency of the oscillator may be set to the desired value by adjustment of the position of the line shorting bar. Excitation may be adjusted by means of the mica trimmer condenser, C_2. Bias is obtained from the grid leak, R_1.

The amplifier is coupled to the oscillator through the trimmer, C_3. A linear tank is also used in the plate circuit of the amplifier. The circuit is tuned by means of the small variable air condenser, C_5. Out-of-phase voltage for neutralizing is obtained by virtue of the grid-filament and plate-filament capacities of the tube which serve to split the tank circuit. C_4 is the neutralizing condenser connected between grid and the "bottom" of the tank circuit. The antenna is coupled by means of the well-known "hairpin" loop adjacent to the amplifier plate line. Bias is obtained from the grid leak, R_3.

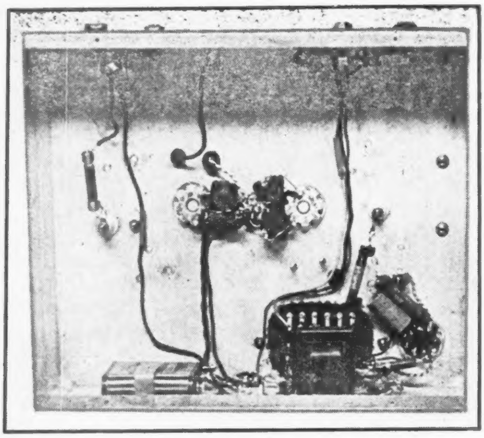
The modulator is quite conventional with a 6L6 operating under conditions approximately Class A. The microphone is fed directly to the grid of the 6L6 through the mike transformer, T_1.



The 2½-meter m.o.p.a. The oscillator is at the left and the amplifier at the right. Jacks in front are for metering connections in grid and plate circuits.

* 1104 West Market, Akron, Ohio.

[1] *QST*, December, 1941, p. 14.



Bottom view, showing r.f. filament by-passing and microphone transformer and battery.

The output of the modulator is coupled to the plate circuit of the r.f. amplifier by means of a 10-watt multimatch audio transformer, T_2.

The transmitter is constructed on a 7 × 9 × 3-inch chassis. The two r.f. tube sockets are submounted about the center of the chassis. Both oscillator and amplifier lines are made of copper tubing 5/16 inch in diameter. Each line consists of two sections of tubing, 15 inches long, bent into gooseneck shape, so that the upper end is close to one of the caps on top of the tube when the lower end is near the chassis. The lower end of each section is flattened out for about an inch so that the pair may be mounted, flat portions overlapping, on a single ceramic button or feed-through insulator set in the chassis. The sections are kept at a uniform spacing of one inch, center to center, by means of small strips of polystyrene drilled to fit the tubing. The oscillator line has additional support, against vibration, from a polystyrene strip extending from a metal angle piece fastened to the chassis to a similar angle piece fastened to the spacing strip on the line near the tube end. The shorting bar for adjusting frequency consists of a pair of metal strips about ½-inch wide and 1½ inches long, curved at the ends to fit the tubing, which clamp either side of the tubing by means of a machine screw at the center of the shorting strips. The oscillator grid condenser, C_1, is connected directly between one end of the line and the tube grid cap, while the other end of the line connects to the plate terminal. The r.f. choke and grid leak in series are connected between the grid cap and a 'phone-tip jack, set in the chassis, which serves as a feed-through insulator to the oscillator grid-meter jack. The excitation control condenser, C_2, connects between the grid terminal and the chassis.

The coupling condenser, C_3, is suspended on heavy leads between the plate cap of the oscillator tube and the grid cap of the amplifier tube. The amplifier line is made similar to the oscillator line with the omission of the shorting bar. C_5 is a small variable-gap air condenser of the type sometimes used in neutralizing beam tubes. The plates are one inch in diameter. The supporting strips for the plates are fastened directly to the ends of the tubing with machine screws through the tubing. The neutralizing condenser, C_4, which is of the same type as C_5, is mounted on top of a 2½-inch stand-off insulator in a position close to the grid cap of the amplifier tube. Very short leads are then required to connect one side of the condenser to the grid cap and the other side to

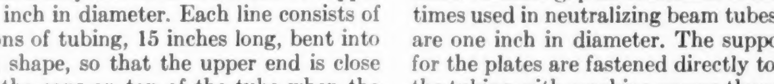


Fig. 1 — Circuit diagram of the 2½-meter oscillator-amplifier.

C_1 — 50-μμfd. silvered-mica fixed.
C_2, C_3 — 3–30-μμfd. ceramic mica trimmer (Hammarlund type MEX).
C_4, C_5 — Adjustable-gap-type air neutralizing condenser, 1-inch plates (Bud NC890).
C_6 — 8-μfd. electrolytic midget.
C_7 — 0.01 μfd.
C_8, C_9, C_{10}, C_{11} — 0.005-μfd. mica.
R_1 — 5000 ohms, 1-watt.
R_2, R_4 — 50-ohm center-tapped.
R_3 — 10,000 ohms, 1-watt.
R_5 — 750 ohms, 10-watt.
R_6 — 25,000 ohms, 1-watt.
L_1, L_2 — See text.
T_1 — Microphone transformer, single-button to grid.
T_2 — 10-watt modulation trans. (UTC S18 or S19).

the proper end of the line. The amplifier grid r.f. choke and grid leak in series are mounted in a manner similar to corresponding units on the oscillator. The antenna coupling loop is made of heavy wire so as to be self-supporting and is mounted on a pair of small stand-off insulators opposite the amplifier plate line.

The 6L6 socket and the output transformer are mounted at the back of the chassis, while the mike transformer is fastened to the rear edge underneath. Meter jacks are placed along the front edge of the chassis, while the mike jack and power-cable connector are at the rear. The mike jack and the two plate-current jacks must be insulated from the chassis, while the two for grid current may be mounted without insulation. Care should be exercised in using the plate-current jacks, since full plate voltage will appear between the exposed portion of the jack and the chassis. The plate-circuit r.f. chokes, filament by-pass condensers and small audio-circuit components are also placed underneath the chassis. The by-pass condensers are soldered directly across the socket terminals.

The entire transmitter may be operated from a single 400-volt, 175-ma. supply. An additional section of filter is used in the high-voltage lead supplying the modulator. This consists of a choke and an 8-μfd. condenser. The purpose of this extra section of filter is both to drop the voltage slightly to 375 for the 6L6 and also to prevent changes in modulator plate current at an audio rate from producing corresponding changes in oscillator plate voltage because of insufficient voltage regulation of the power supply.

Plate voltage should not be applied to the amplifier until it is neutralized. The frequency of the oscillator should be first set to the center of the band by adjustment of the shorting bar, moving it toward the tube to increase frequency and away from the tube to decrease frequency. If the dimensions given are followed closely, the circuit should tune to 113 Mc. with the shorting bar 2½ inches from the chassis end of the line. C_2 and C_3 should then be adjusted for maximum amplifier grid current consistent with reasonable oscillator input. In my particular case, the circuit functioned best with C_3 about two-thirds closed. It should be possible to obtain a grid current of at least 15 ma. without difficulty. Since the adjustment of both C_2 and C_3 will have an effect upon the frequency of the oscillator, the frequency should again be set to the center of the band before attempting to neutralize the amplifier.

With the oscillator running, there will be a noticeable change in amplifier grid current when C_5 is tuned through resonance. Keeping C_5 adjusted so that the amplifier is near resonance, the neutralizing condenser, C_4, should be adjusted in small steps until the grid current stays perfectly steady as the plate current is tuned through resonance, indicating that the amplifier is neutralized. The oscillator may now be set to the desired frequency and C_2 and C_3 readjusted for optimum performance. It will be found that the adjustment of C_2 will have an effect upon the stability of the oscillator as well as upon the efficiency and output. It should be set at the best compromise adjustment. An indication of excitation may be obtained by checking the grid current of the oscillator. With the amplifier coupled, the oscillator grid current should run between 10 and 12 ma., while the plate current will be approximately 60 ma.

With no antenna attached to the output terminals, and the oscillator running, plate voltage may now be applied to the amplifier and the plate circuit tuned accurately to resonance as indicated by the dip in plate current. If the circuit is working properly, the plate current should dip to a minimum of about 18 ma. Since no fixed bias is provided, plate voltage should never be applied to the amplifier until after the oscillator has been turned on and is supplying excitation. To test the performance of the amplifier, a 10-watt bulb may be connected to the output terminals. Coupling may be adjusted to cause an increase of plate

(*Continued on page 116*)

Another view of the 112-Mc. oscillator-amplifier, showing the mounting of the amplifier tuning and neutralizing condensers. The modulator is in the foreground. The jack in front is the mike connection and the socket for power-supply input.

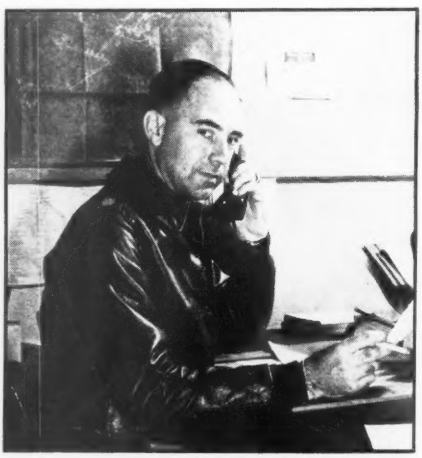
IN THE SERVICES

THE response to the new form of this column is 100 per cent. We thought it might please some and disappoint others, but, believe it or not, there has not been a single adverse comment — and there have been many compliments. So it stays as is, unless someone can suggest an improvement.

While there is no news matter, it does allow more names in the space allotted and makes it easier to find calls. If you find yourself classified wrongly, it is simply because the information received was insufficient to put you exactly where you belong. A postal card with the right information will keep our roster correct and up-to-date. Will you do your part?

FIELD AND COAST ARTILLERY

1CEQ, Googins, Capt., foreign duty.
1HLY, Ebbitts, Sgt., Ft. H. G. Wright, N. Y.
1LOR, Wittman, Tech. Sgt., address unknown.
1NQV, Archer, Staff Sgt., Ft. Terry, N. Y.
2MZC, Andersen, Ft. Monroe, Va.
4HLL, Uhorchak, Sgt., foreign duty.
5JHV, March, Lt., Palacious, Texas.
6LYQ, Preble, Pvt., foreign duty.
K6TYH, Young, Staff Sgt., foreign duty.
7AOL, Shaw, Technical Sgt., Ft. Stevens, Oregon.
8NGA, Green, Ft. Monroe, Va.



Don Meserve, W1FL, formerly ARRL's advertising manager from 1928 to 1932, is now a full-fledged Lt.-Colonel in the Signal Corps stationed at Presque Isle, Maine. Starting Army duties in medium artillery, he was transferred to Signal Corps work and is well satisfied with the change. What ham wouldn't be? *Official U. S. Army Photo.*

8SPK, Mason, Pvt., Ft. Sill, Okla.
8HTS, Deahl, Pvt., Ft. Sill, Okla.
8WPK, Walters, Cpl., Camp Claiborne, La.
9EGH, Bruening, Staff Sgt., Camp Roberts.
9FRF, King, Sgt., Camp Gordon, Ga.
9IOG, Mitchell, Ft. Monroe, Va.
9IYV, Osterhoff, Tech. Sgt., address unknown.
9KTR, Spillman, Staff Sgt., foreign duty.
9TYE, Genung, Capt., foreign duty.

NAVY — FOREIGN OR SEA DUTY

For obvious reasons we cannot publish the location of men on vessels or duty outside the continental limits of the United States. We must be content, therefore, with listing only their names, calls, and rank or rating:

1EMR, Stafford, CRE; 1EYS, Hopkins, Lt.; 1FPA, Steele, Lt.; 1LCJ, Weinberg, SM3c; 1MQC, Cowette, Sea2c; 2IQY, Fusco, RM2c; 2KJK Weinberg, RM2c; 3QV, Martin, Lt.; 4EKM, Sims, RM2c; K4FAY, Haley, CRM; 4GCS, Armstrong, RM2c; 5BAM, Harrison, Lt. (jg); 5ECB, Smykal, RM1c; 5ILG, Breithaupt, RM2c; 6AME, Potts, RM1c; 6FCX, Simpson, RE; 6FPX, Thorpe, RE; 6IYH, Albrect, RM1c; 6MAV, Halliday, Ens.; 6OSV, Gajewski, CRM; K6OWT, Hall, Lt. (jg); 6PIP, Snyder, RM1c; 6PVS, Beadles, RM1c; 6QBJ, Miller, RM3c; 6QLU, Gunther, RM2c; 6RZG, Germo, RM3c; 7GBV, Geisert, Ens.; 7QXD, Scheible; 8MWV, Lange, RM1c; 8RTU, Devey, Ens.; 8SCJ, Simon, RM3c; 8SDI, Thompson, RM2c; 9BGN, Ritter; 9DHH, Hendricks, RM2c; 9DUO, Shirk, Lt.; 9IQF, Steege, RM1c; 9KZU, Butgereit, RM2c; 9MBA, Touw; 9MYP, Dulevich, Ens.; 9NTK, Albert, Lt.; 9TCU, Keats, Ens.; 9ZYS, Geeting; and Hartl, RM3c, op. license only.

ARMY — GENERAL

1GKU, Titcomb, 1st Lt., foreign duty.
1LKY, Jones, Staff Sgt., Ft. Devens, Mass.
ex-2BX, Clarke, Capt., foreign duty.
2CTO, Ehrler, foreign duty.
2JSF, Salisbury, Technical Sgt., foreign duty.
2JXF, McNally, Lt., Washington, D. C.
2LZM, Sinofsky, Pvt., Ft. Dix, N. J.
2LZO, Chulsky, Pfc., Ft. Ord, Calif.
2MCV, Lester, Cpl., Ft. Bragg, N. C.
2NTU, Albrechtsen, Sgt., Ft. Riley, Kansas.
3ASG, Mkitarian, Capt., Sewell, N. J.
3CZW, Smith, Major, Washington, D. C.
3HFC, Haase, Technical Sgt., Camp Maxie, Tex.

3JYF, Bitting, Master Sgt., Wilmington, N. C.
4FFL, Few, 2nd Lt., foreign duty.
4GCJ, Davenport, Shaw Field, S. C.
5AOT, Brown, Lt., foreign duty.
5BPL, Thomas, Staff Sgt., foreign duty.
5DRX, Bogard, address unknown.
5DTT, Wade, Lt., Washington, D. C.
5GTX, Gordon, Tech. Sgt., Camp Good, Tex.
K6PDQ, Reynolds, Master Sgt., foreign duty.
6PWD, Yamamoto, Pvt., Camp Crowder, Mo.
6QOP, Kaklikian, Sgt., Fresno, Calif.
K6TOL, Blauvelt, Major, Ft. Benning, Ga.
8BFF, Kahn, address unknown.
8HZE, Shawl, Pvt., foreign duty.
8LGE, Barket, Cpl., Coral Gables, Fla.
8PSD, Emery, Cpl., foreign duty.
8QBS, McDaniel, Sgt., foreign duty.
8QBX, Willis, Pvt., address unknown.
8VDD, Weygandt, Sgt., address unknown.
8VTL, Holland, Sgt., address unknown.
8WRQ, Smith, Cpl., address unknown.
9BML, Woods, address unknown.
9BNC, Graham, Lt., foreign duty.
ex-9JHB, Sanner, Major, Ft. Dix, N. J.
9KOW, Hempy, Pvt., Bakers Field, Calif.
9MGA, Clay, Barksdale Field, La.
9OWD, Griffith, Capt., Washington, D. C.
9QKR, Mack, 2nd Lt., address unknown.
9RGF, Ferris, Lt., Miami Beach, Fla.
9SZC, Graham, address unknown.
9UJQ, Stopka, Ct, foreign duty.
9UWY, Fisher, Capt., Washington, D. C.
9WWD, Burrows, Cpl., foreign duty.
9YCD, Cunningham, Alamo Field, Tex.
9YLA, Gabrielson, Lt., foreign duty.
Operator's license only:
Gilbert, address unknown.
Lowish, Staff Sgt., Converse, Tex.
Orr, Sgt., Ft. Lewis, Wash.
Politi, Pvt., foreign duty.
Simpson, Pvt., Tyndall Field, Fla.
Sutherland, address unknown.
Woods, Cpl., Camp Blanding, Fla.

MARINE CORPS

1IWX, Soares, Staff Sgt., New River, N. C.
2ART, Ginsberg, Staff Sgt., New River, N. C.
2GEI, McDonough, Staff Sgt., New River, N. C.
2IMD, Brown, Staff Sgt., New River, N. C.
2NCB, Bryant, Staff Sgt., New River, N. C.
2NWX, Loew, Staff Sgt., New River, N. C.
4AGI, Smith, Capt., Camp Murphy, Fla.
4DQC, Graham, Staff Sgt., New River, N. C.
4ICN, Meek, Staff Sgt., New River, N. C.
5HHV, Leveque, 1st Lt., Camp Murphy, Fla.
7HHP, Ball, Staff Sgt., New River, N. C.
8BOM, Mastrianni, address unknown.
8RMP, Rex, Staff Sgt., New River, N. C.
8SZD, Edwards, Staff Sgt., New River, N. C.
9JFO, Niewiadowski, Staff Sgt., Corpus Christi.
9JHD, Baggerman, Staff Sgt., Corpus Christi.
9LGC, Woodward, Pvt., San Diego, Calif.
9LHW, Movetti, Pvt., San Diego, Calif.
9LQR, Knapp, Staff Sgt., Corpus Christi, Tex.
9NWH, Costanza, Staff Sgt., New River, N. C.
9RLA, Weichmann, Staff Sgt., New River, N. C.
9ZRO, Giorgis, Staff Sgt., New River, N. C.
9ZXL, Schiffmann, address unknown.
Kraemer, Sgt., op. license only, New River, N. C.

Dr. (now Captain) Elmer A. Volzer, W8SIX, of Canton, Ohio, is now in the Medical Corps at Ft. Leonard Wood, Missouri. Licensed in 1919 as W8RS and a charter member of the Canton Amateur Radio Club, he has been intimately connected with amateur radio ever since. Electrons are in the Volzer blood, as W8SQW is his brother and W8UYL his uncle.

ARMY—SIGNAL CORPS

1DCT, Andrews, Ft. Monmouth, N. J.
1HJS, Cionti, Ft. Monmouth, N. J.
1KAN, Magee, Ft. Monmouth, N. J.
1KCP, Saltus, Ft. Monmouth, N. J.
1KRV, Steventon, Ft. Monmouth, N. J.
1LDL, Langhammer, Ft. Monmouth, N. J.
1LKW, Donovan, Ft. Monmouth, N. J.
1MME, Rudderham, Ft. Monmouth, N. J.
1MYJ, Colby, Ft. Monmouth, N. J.
1MZT, Stone, Ft. Monmouth, N. J.
1NGI, Chatkin, Ft. Monmouth, N. J.
1NMC, Schatzman, address unknown.
2AAN, Hart, Pvt., Ft. Monmouth, N. J.
2AHN, Sieder, Capt., Philadelphia, Pa.
2DXL, Lando, Cpl., Ft. Monmouth, N. J.
2EQD, Skinner, Ft. Monmouth, N. J.
2FEC, Schermerhorn, Pvt., Ft. Knox, Ky.
2IDT, Gralewski, Ft. Monmouth, N. J.
2IMT, Klace, Pvt., Ft. Monmouth, N. J.
2KRK, Ala, Ft. Monmouth, N. J.
2LLQ, Horowitz, Pvt., Ft. Monmouth, N. J.
2MRZ, Kaufman, Ft. Monmouth, N. J.
2NHQ, Nemoyten, Pvt., Ft. Monmouth, N. J.
2NSY, Wohl, Ft. Monmouth, N. J.
3AZY, Grove, Ft. Monmouth, N. J.
3DDM, Hop, Sgt., foreign duty.
3ESH, Plesser, 2nd Lt., Camp Crowder, Mo.
3ETL, Lownsbury, Ft. Monmouth, N. J.
3EYS, Burnett, 1st Lt., address unknown.

3HAZ, Petty, Ft. Monmouth, N. J.
3HSR, Munnell, 2nd Lt., Duncan Field, Tex.
3IBF, Katona, Ft. Monmouth, N. J.
4BHS, Robinson, Ft. Monmouth, N. J.
4HLZ, Shaw, Ft. Monmouth, N. J.
4HSG, Spittle, foreign duty.
4UN, Watson, Ft. Monmouth, N. J.
5ACW, Chance, Capt., foreign duty.
ex-K5AK, Ferguson, Sgt., Ft. Monmouth, N. J.
5DPM, Chatellier, Ft. Monmouth, N. J.
5EIJ, Woosley, Ft. Monmouth, N. J.
5FPW, Kolski, Master Sgt., Ft. Monmouth, N. J.
5HTZ, Berrie, Ft. Monmouth, N. J.
5HVF, Ray, Sgt., foreign duty.
5ICJ, Kucera, Capt., foreign duty.
5IEH, Spain, Lt., foreign duty.
5OW, Cooke, Capt., Washington, D. C.
ex-6BNR, Gibbon, Pvt., Ft. Monmouth, N. J.
6MJI, Lazar, Ft. Monmouth, N. J.
K6PKJ, Bingham, Ft. Monmouth, N. J.
6PXH, Kahn, Pvt., Camp Murphy, Fla.
6UDX, Benson, Ft. Monmouth, N. J.
7EXE, Jacobson, Pvt., foreign duty.
7GQG, Vogel, Ft. Monmouth, N. J.
7GZN, LaRue, Pvt., foreign duty.
9DHP, Farber, Ft. Monmouth, N. J.
ex-8LTP, Fontaine, Pvt., Ft. Monmouth, N. J.
8RCX, Koves, Staff Sgt., foreign duty.
8SEB, Rhodes, Ft. Monmouth, N. J.
8UGI, Presky, Ft. Monmouth, N. J.

At the U. S. Naval Training Station, Great Lakes, Ill., there are 2200 recruits under training. This ought to hold the Axis when these men finish schooling and go to sea and shore duty.

8UYU, Glancy, Lt., foreign duty.
8UZJ, Wrase, Camp Crowder, Mo.
8WDD, Kovach, Ft. Monmouth, N. J.
8WJU, Wright, Ft. Monmouth, N. J.
8WS, Phillips, Ft. Monmouth, N. J.
9ALC, Coulson, Chicago, Ill.
9BDF, Mack, Lexington, Ky.
9CBS, Kaas, Cpl., Camp Crowder, Mo.
9CTC, Wiltgen, Ft. Monmouth, N. J.
9CWN, Burkhead, Ft. Monmouth, N. J.
9ELH, Brzana, Ft. Monmouth, N. J.
9FEK, Gladson, Ft. Monmouth, N. J.
9FRM, Rempfer, Pvt., Leesville, La.
9JGL, Allen, Ft. Monmouth, N. J.
9JPO, Rohner, Tech. Sgt., Mac Dill Field, Fla.
9KPG, Heinrich, Ft. Monmouth, N. J.
9KQQ, Plasschaert, foreign duty.
9MWD, Perthel, Ft. Monmouth, N. J.
9NQZ, Novak, address unknown.
9US, Kamin, Major, Washington, D. C.
9VFZ, Middleton, Ft. Monmouth, N. J.
9YZE, Turner, Pvt., Camp Crowder, Mo.
9ZBG, Kuning, Ft. Monmouth, N. J.
Struthers, Pvt., op. lic. only, Ft. Monmouth

NAVY—GENERAL

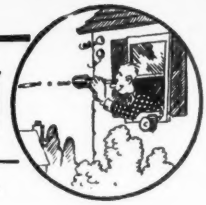
1AFD, Snow, address unknown.
1AVG, Bowden, address unknown.
1CMB, Chapman, address unknown.
1EWN, Hill, Portland, Me.
1FGC, Slavin, Lt. (jg), address unknown.
1JLR, Barnes, Ens., Washington, D. C.
1KPL, Sawtelle, address unknown.
1KVH, Mahoney, Lt., Pensacola, Fla.
1LGT, Corby, RM3c, address unknown.
1LWA, Hurlbut, ARM2c, Cape May, N. J
1MQX, Hanko, Boston, Mass.
1NGG, Snow, RM2c, Los Angeles, Calif.
2IKM, Jones, Lt., Great Lakes, Ill.
2JTA, Meline, RM2c, Los Angeles, Calif.
2KOT, Glassman, AS, Boston, Mass.
2LC, Rooke, Lt., address unknown.
2LCM, Moffat, Lt. (jg), address unknown.
2NDL, Slizen, Newport, R. I.
2NTN, Bishop, Sea1c, New York, N. Y.
2OHC, Antosyn, San Francisco, Calif.
2RP, Barnes, RT2c, address unknown.
3AJS, Keener, Lt., Norfolk, Va.
3AOI, Ellison, Lt. Cmdr., Washington, D. C.
3FFK, Schmidt, CRM, Indianapolis, Ind.
3GGY, Lee, RM2c, Los Angeles, Calif.
3GLG, Carson, CWO, address unknown.
3HZM, Wagoner, RT2c, Philadelphia, Pa.
3IHJ, Huggett, RM1c, Washington, D. C.
3JFJ, Glenn, address unknown.
3JPF, Reynolds, ACRM, Jacksonville, Fla.
4BBS, Roberson, CRM, Southport, N. C.
4COZ, Browne, RM3c, Banana River, Fla.
4CRW, Roddey, RM2c, Corpus Christi, Tex.
4DDM, Knight, Lt., Miami, Fla.
4DMW, Griffin, RM2c, Los Angeles, Calif.
4EEA, DeLay, Sea1c, Los Angeles, Calif.

4ELA, Emmons, RM3c, Bellevue, D. C.
4FIX, Duncan, Ens., address unknown.
4FYI, Eledge, RM2c, Treasure Island, Calif.
4GW, Kiibler, Lt., Key West, Fla.
4GYB, Rogers, RM2c, Corpus Christi, Tex.
4HDO, Sills, ARM2c, Corpus Christi, Tex.
4HVF, Knight, RT3c, Charleston, S. C.
4IBW, Catlin, Ens., Boston, Mass.
5ABG, Floyd, RT3c, Houston, Tex.
5AUL, Talbutt, address unknown.
5BGZ, Yeary, address unknown.
5CSD, Hotard, Ens., Mobile, Ala.
5EBI, Schmuck, RT3c, Houston, Tex.
5EIV, Mullen, address unknown.
5EUF, Hoblit, Quonset Point, R. I.
5EUO, Mills, AMM2c, Corpus Christi, Tex.
5FEW, Suter, RM3c, New Orleans, La.
5FTM, Adair, address unknown.
5GCJ, Lee, address unknown.
5GEF, Smith, RM3c, Los Angeles, Calif.
5GON, Langham, RM2c, Los Angeles, Calif.
5IBL, Majoue, RM2c, Los Angeles, Calif.
5IRM, Graff, RM2c, Los Angeles, Calif.
5KEM, Walenta, address unknown.
5KJU, Moffitt, RM2c, Los Angeles, Calif.
5KKY, Hunter, RM2c, Los Angeles, Calif.
6KTM, Harvey, RM2c, Los Angeles, Calif.
6LWD, Balliet, RM2c, Los Angeles, Calif.
6LZL, Couzin, RM2c, Los Angeles, Calif.
6NQY, Rollins, CQM, address unknown.
6NZH, Nunes, RM3c, Los Angeles, Calif.
6QIL, Furlong, RM3c, San Diego, Calif.
6SDJ, Baker, Lt. Cmdr., Washington, D. C.
6SID, French, Ens., Ft. Schuyler, N. Y.
K6UQH, Ambrose, ARM2c, San Diego, Calif.
7AMG, Nichols, Lt., Bremerton, Wash.
K7GZH, Duff, CRM, address unknown.
7HFW, Sherman, RM3c, Los Angeles, Calif.
7IAL, Hull, RT2c, Corpus Christi, Tex.
7IJZ, Soper, RM3c, Bailey Isl., Mass.
7IVR, Beagles, RT2c, Houston, Tex.
8AKG, Frantz, Lt. (jg), address unknown.
8AVK, Glaes, Norfolk, Va.
8BSF, Seigler, RM2c, Los Angeles, Calif.
8CGZ, Smith, address unknown.
8DSK, Peacock, RT2c, Houston, Tex.
8EHM, Wagstaff, PhM2c, Manchester, N. H.
8EVE, Bricker, RM2c, Los Angeles, Calif.
8GMI, Smith, RM2c, Los Angeles, Calif.
8HMH, Moore, RT2c, Washington, D. C.
8HWW, Sherman, address unknown.
8LVG, Crooks, RM2c, Los Angeles, Calif.
8MDB, Kemery, address unknown.
8MOX, Bausinger, address unknown.
8MOY, Berninger, address unknown.
8MPB, Fegley, address unknown.
8NOH, Gerbert, RM2c, Great Lakes, Ill.
8NVL, Lodewyk, RM2c, Los Angeles, Calif
8OGB, Voigt, RM2c, Los Angeles, Calif.
8RLB, Lempke, Lt., address unknown.
8RQ, Startzell, Lt., Quonset, R. I.
8SMH, Phipps, Lt. (jg), address unknown.
8TRJ, Paananen, RT3c, Houston, Tex.
8TSZ, De Chambeau, RT2c, Philadelphia, Pa.
8VLG, Prechtl, address unknown.
8VLK, Justavick, address unknown.
9AKP, Kennedy, Indianapolis, Ind.
9AQE, Smith, Lt. Cmdr., address unknown.
9BAE, Bayles, Lt., Fishers Isl., N. Y.
9BHH, Nylander, RM1c, address unknown.
9BVZ, Lewis, address unknown.
9CLE, Beaubier, address unknown.
9CRF, Schillo, Lt. (jg), Jacksonville, Fla.
9CVL, Johnson, Lt. (jg), Hanover, N. H.
9CYM, Clay, ARM3c, Pensacola, Fla.
9GKW, Shorn, address unknown.
9JUJ, McCarty, Great Lakes, Ill.
9KIM, Koepp, RT2c, Stillwater, Okla.
9LBP, Hart, Lt., Hanover, N. H.
9LRF, McCracken, Sea1c, Los Angeles, Calif.
9LXB, Ellifrit, Lt. (jg), Newport, R. I.
9MKT, Townsend, Sea1c, Washington, D. C.
9MN, Berry, Lt. Cmdr., address unknown.
9MSY, Foote, Ens., address unknown.
9NQO, Grubich, RT3c, Great Lakes, Ill.
9PPK, Moulds, AS, Great Lakes, Ill.
9RDM, Engelking, RT2c, Great Lakes, Ill.
9SEK, La Frentz, RT2c, Houston, Tex.
9TYH, Johnson, address unknown.
9UAA, Hallett, Lt. (jg), Corpus Christi, Tex.
9UCA, Mohrlant, RT3c, Houston, Tex.
9VPL, Kell, EM2c, Great Lakes, Ill.
9WQP, Gross, address unknown.
9WUC, Henry, Lt. Cmdr., Great Lakes, Ill.
9YPC, Green, address unknown.
Operator's license only:
Buffington, RT2c, Houston, Tex.
Doig, College Station, Tex.
Franklin, RT3c, Houston, Tex.
Jones, RT2c, Houston, Tex.
Scherenzel, RT2c, Houston, Tex.

ARMY—AIR FORCES

1BDI, Handy, Lt. Col., Washington, D. C.
1BEQ, Loyzim, 2nd Lt., Maxwell Field, Ala.
2AQQ, Hecht, Pfc., address unknown.
2ATA, DeMuth, Pvt., address unknown.
2BSB, Ainsworth, address unknown.
2HHS, Cantrell, Tech. Sgt., Mitchel Field, N. Y.
2JNS, Haut, Pvt., Bowman Field, Ky.
2JUU, Yost, Capt., Philadelphia, Pa.
2LFX, Scott, Lt., Farmingdale, N. Y.
2NVD, Kulze, Pfc., address unknown.
2NVH, Scherer, A/C, College Station, Tex.
3CQR, Pettengill, Master Sgt., address unknown.
4KV, Spratlin, Lt., Miami Beach, Fla.
5BGC, Wilson, Lt., Perrin Field, Tex.
5EBF, Beatty, Lt., Colorado Springs, Colo.
5TD, Tennant, Capt., West Palm Beach, Fla.
6ANT, Honeywell, 1st Lt., Miami Beach, Fla.
6DTL, Baboian, Richmond, Va.
6GEG, McLaughlin, Lt., Miami Beach, Fla.
6NFF, McLaughlin, 2nd Lt., Miami Beach, Fla.
6OCX, Stillwell, Tech. Sgt., foreign duty.

EXPERIMENTER'S SECTION



Address correspondence and reports to ARRL, West Hartford, Conn.

PROJECT A

Carrier Current

On wired radio, I have the pleasure to report the first known contact between Burbank and Glendale, each with its own power system. W6ULE reported hearing signals from the automatic tape transmitter here. Tests have shown the signal was coming in over the wire line, since it could not be heard with ordinary outside antennas. To-night contact was established, but signals were too weak in relation to noise to permit a good QSO. With improvement in equipment at both ends, better results are expected. W6ULE is using about 10 watts input. At W6MEP input is now about 25 watts to push-pull 10s in a Hartley circuit. Line input current is now 0.4 to 0.55 amperes.

Many more hams are becoming interested and it will only take some more results like these to-night to get a great many more interested.

About three weeks ago, I checked at W6ETI, W6HE, and W6JUJ, local hams, for reception of my signals. At that time signals were only audible at W6ETI, with strength about S6 with 12 watts input. Since W6HE and W6JUJ are in widely separated parts of town, probably on different feed lines, this was not surprising. However, W6ULE is farther away and on a different power system, but I guess the power increase accounts for that.

QSO with W6UCW has been resumed again with good results on 'phone. W6UCW is about 1¼ miles airline, W6ETI about one mile, W6HE about 3 miles, W6JUJ about 2½ miles, but W6ULE is about 4½ or 5 miles and completely across town. — *Art Gentry, W6MEP.*

Following is a report on the progress of wired wireless in Glendale, Calif. So far, many hams and SWLs are building equipment, but the only active station in Glendale at the present time is W6ULE. He has been having daily QSOs with W6MEP in Burbank. W6MEP is more than four miles away airline and is served by a different power company. This seems to prove that in urban areas, it makes very little difference if the wired wireless is carried on between hams served by different power companies.

Among the W6s building equipment are UQA, TEU, TLU and STA. TFP was on 'phone for a short time before he enlisted in the Air Corps and he succeeded in working W6ULE, about a mile from him.

W6MEP is still running his automatic sender almost every night from about 6:30 P.M. to 9:00 P.M. PWT. W6ULE has built up a similar automatic sender and is sending his call from about 7:00 to 9:30 P.M.

W6TEU's converter has a stage of i.f. after it and it converts to 900 kc. so he won't have to change plug-in coils. The boys who have built converters have noticed that the noise level can be cut down by adjusting the screen-grid resistor until there is about 40 or 50 volts on the screens. This means a resistor of from 80,000 to 150,000 ohms instead of the 20,000-ohm resistance usually used. Also, a 262-kc. i.f. coil seems to peak better than the 175-kc. variety. — *Frank Williams, W6ULE.*

William Schmidt, W9OZN, a power company employee at Udall, Kansas, has been doing some interesting experimental work at a substation where he works. He first fed his transmitter into a 115-volt secondary of a transformer whose primary was operating from one phase of a 12,000-volt, 3-phase, open-wire transmission line. With this arrangement, he was able to pick up the signal at a distance of six miles by following the 12-kv. line with a mobile receiver. He then connected two open-wire lines to the 115-volt secondary. These lines ran in opposite directions from the station and were fastened on the poles carrying the 12-kv. line, 4 feet below and parallel to the high-voltage line. Each line was approximately 300 feet long and open-circuited at the far end. With the transmitter coupled as before at the station, the signal was S9 at a distance of 15 miles from the station and was reported weak but readable at 30 miles!

W9OZN says that many hams should have a similar set-up available, since it requires only that the secondary wires feeding his station run parallel to the primary wires for a few hundred feet.

The transmitter used for his tests consisted of an 809 in a circuit similar to that described in *QST* for March, with slight alterations to suit the change in tube. The amount of power used did not seem to be important, since he was able to reduce the plate voltage to 300 without noticing any change in signal strength. He did, however, seem

(Continued on page 110)

Easy Lessons in Cryptanalysis: No. 6

BY JOHN HUNTOON,* W1LVQ

As Ed Wilson opened his back door in response to the insistent buzz, he found his visitor-protégé at full military attention, right hand raised in a smart salute.

"Good evening, Private Wilson," his visitor chuckled.

"Cut the comedy, m' fran," Ed cautioned. "The draft board'll get you, too, as soon as Congress lowers the age minimum another notch!"

Jim Bremer grinned. "What'cha gonna be — a general or something?"

"Not until after a few weeks' basic training. But say, didn't you come over here to learn, not to talk?"

"Yes, Major! I'm ready, sir."

"Okay. To-night, Jimmy boy, I'd like to show you a few miscellaneous cipher methods, just so you won't be stumped if you run across some of them. The systems I've given you before have been pretty much standard and fundamental.

"There are certain possibilities you should keep in mind, such as double transposition, or double substitution, or encipherment once by each system. For example, the phrase **War Bonds and Stamps** might be enciphered by simple substitution to **VZQAN MCRZM CRSZL ORXXX** and then transposed from a 4 × 5 square to **VMCOZ CRRQR SXAZZ XNMLX.** A frequency count would indicate that it was a simple substitution, but it would be extremely difficult to solve since all normal digraphs, trigraphs and repeated words would be broken up."

Jim wrinkled a youthful brow. "I suppose that if I were attacking such a cipher on the assumption of simple substitution, without any success, I'd take a long shot and try rearranging the text by various transposition methods?"

"That's about all you can do. You should try to end up with a transposed cipher text showing repeated sequences, such as **MCR** for **nds** in this one."

Ed stopped a moment to light his favorite briar before continuing. "Then there are the simplest ones — often troublesome by their very simplicity — illustrated in an elementary fashion by the common spelling aid **A Rat In The House Might Eat The Ice Cream.** Or one which recently appeared in *The Cryptogram,* as **Chop, smite every human being. Scare the mice. Cut and slaughter the tadpoles, remove their head, none shall live. Can you this solve?** By selecting letters 1, 3, 6, 10, 15, 21, etc., we find the simple hidden text **Come here at once.**"

"Shucks, who'd want to spend that much time in making up a text and transmitting it?" Jim asked.

"You're right, of course; no one would, and this type of cryptogram is practically never used in radio transmission. But to get to one which is, a transposition using an incomplete geometrical figure is a stickler. For example, take the phrase **civilian defense warning center** and write it in rows of five units each:

c i v i l
i a n d e
f e n s e
w a r n i
n g c e n
t e r

"Now, transcribing vertically we would get **CIFWN TIAEA GEVNN RCRID SNELE EIN.** Having such an unknown cipher, with a count of 28 letters we'd naturally try rectangles of 7 × 4, 14 × 2 in all kinds of routes — without success.

"But here's one way it could be done. We'd make up six or eight paper strips and write the cipher text on them vertically. Then we'd take the first few letters **CIFWN** of one strip and, using another strip as a slide alongside it, attempt to find a position which would give some frequent possible digraphs. The first likely one would be the combinations **ci, ia, fe, wa, ng.** We'd then count the interval from **c** to **i;** finding it to be six, we'd try the third strip at an additional interval of six and be very happy to discover the combinations **civ, ian, fen, war,** and **ngc,** The rest is easy." Ed's slide settings at this point were:

Ed drew on his pipe again, and went on. "Then there's 'book cipher,' a system using numbers to

* Assistant Secretary, ARRL.

indicate the page, line and position of selected words. The dictionary is the most-used book for this purpose — but of course both parties have to use the same edition! Here, I've made up a sample cipher of this type using the ARRL masthead in *QST*, with the first digit or digits to represent the number of the line and the final one the position of the word in that line. I'll give it to you for homework, so you can see how it operates.

"Now let's take a brief look at what might be called an 'indicator' system — where the cipher letters act as geometrical indices to the location of the true plain text letters in a chart. A very simple one might be set up in this fashion." Ed wrote rapidly:

	L	**E**	**A**	**R**	**N**
R	a	b	c	d	e
A	f	g	h	ij	k
D	l	m	n	o	p
I	q	r	s	t	u
O	v	w	x	y	z

"We have a 25-cell square but a 26-letter alphabet, which situation we overcome by combining two letters in one cell; **i** and **j** are suitable ones since they seldom will be mistaken for each other in plain text.

"Now, each plain text letter is enciphered by the two indices to its location. Letter **c** for example, is represented by **RA; m** by **DE;** and so on. The main drawback is that two cipher letters are required for each plain text letter, so the length of the transmitted text is doubled and therefore much valuable time is lost in transmission. Too, the system is no more secure than simple substitution, since pairs of letters will behave like individual English letters and methods of solution can be the same as for simple substitution. But if the system is known, there's another means of solution which is often easier. Suppose we have this text:

EJJRN MNMSO NOERE AOAJR JMEAE ONOEO OJJRT JOOOA NJJMN MJJNO EANRE J.

"We find that the only letters appearing are **EJRNMSOA.** Our two key words are doubtless each five letters in length — and from the possibilities we can form **major, smear, marne, jones** and the like. We notice from our normal-alphabet square that the third and fourth columns and rows contain a greater proportion of high-frequency characters than the others **(lmno, rstu,** and **hns, iot)** and therefore we'll select as possible keywords those whose third and fourth letters appear frequently in the cryptogram, such as **J, O, N, E.** Noticing **S** appears but once, we can be pretty certain it comes at the end of one of the keywords to represent the **vwxyz** section. We also note that there are only eight different cipher letters, meaning two are used twice; the high occurrence of **J** and **O** singles them out as the probable duplicated letters. Adding all this together, and making a few tries, we arrive at the words **major** and **jones** and the message becomes easily readable."

"Couldn't the plain text letters be jumbled around to confuse the analyst, maybe in accordance with some key?" Jim inquired.

"Yes, but the system is still vulnerable by simple substitution methods. Besides, its excess length makes it undesirable. I was showing it to you merely to work up to a bi-literal substitution type called *Playfair*. It employs a plain-text block identical to the one we just used — but without indices, since the substitutions are in the square itself. To encipher, the plain text is divided into two-letter groups. When a pair of such letters appear at the opposite corners of a rectangle in our chart, the two letters at the other corners are substituted; as, **gu** becomes **KR.** When a pair of letters are found in the same horizontal row, the two letters at the immediate right of each are substituted; as, **ol** becomes **PM.** When a pair of letters is found in the same vertical column, the two letters immediately below each are substituted; as, **br** becomes **GW.**"

"Hey! What happens if one of two plain text letters in a column appears at the bottom?" Jim countered. "There's no letter below it."

"In that case, substitute the letter at the top of the column; as, **sx** becomes **XC.**"

"I get it," Jim said gleefully. "And if one of

(Continued on page 106)

As implied above (and reported elsewhere in this issue), "Ed Wilson," alias John Huntoon, has gone into the service, and his hundreds of cryptanalysis disciples will be without the benefit of his genial counsel for some time to come. He can leave with the consciousness of having done an effective as well as entertaining job of instruction in an intricate art of great war-time value.

That job is now complete, and this installment terminates the series. It had to be finished up a little faster than originally contemplated, for Uncle Sam doesn't like to wait. But the fundamentals have been covered, and anyone who knows all the principles outlined in this series is well fitted for advanced training — which, logically, should come under government supervision.

This doesn't mean that *QST* is necessarily finished with the subject of cryptanalysis as a whole, of course, and contributions from the "Jim Bremers" or any of the old-timers who may still be around will be welcomed. — EDITOR.

How Recordings Are Made

No. 5 — Tests and Trouble-shooting

BY CLINTON B. DE SOTO,* W1CBD

THIS article concludes the series on the fundamentals of recording. In the four preceding installments, the basic principles, the recorder proper, the amplifier and the playback system have been considered in detail. Now we shall discuss some of the operating practices — trouble-shooting notes, hints and kinks, the fine points of technique — found useful by experienced recording experts.

Before going into that, though, we want first to acknowledge the response to this series on the part of the fraternity at large, indicating, first, an interest in home recording as a war-interim means of keeping the radio bug fertile, and second, interest in learning a little about recording technique as a possible means of adding to one's own ultimate utility in the war effort.

We're not the ones to advocate ham boondoggling when there's a war to be fought. But we do believe that every one of us — male or female, Class I or IV-F — should make every effort to equip ourselves in every way possible, for any need that may arise in the carrying on of the war. And we do know that there's no more successful formula for training than the ham way — learning to do something because you're so interested in it that you *have* to learn. And, since recording can be, in its own way, a small contribution, we are interested in promoting it in every way practicable.

In line with this thought, we reproduce here portions of a 6-inch "home recording" received from Robert K. Holsinger, W8SOF. That W8SOF is a ham who practices what he preaches is demonstrated by the fact that he recorded his message instead of writing it. Here is part of what he has to say:

> . . . How about running a small column in *QST* giving a list of amateurs who are doing recording and would like to swap records with other amateurs? Amateurs can communicate with each other by mike or key as they want to, just like they used to in radio but using records. Put them in a folder and send them through the mail to another amateur. Amateurs could swap recordings that way and QSO through the mail, instead of through the ether. . . . How about that, Clint — QSOs by records? . . .

That W8SOF's proposal is a perfectly practical one is demonstrated by the fact that some hams already are doing it. One instance we know of is the weekly "record schedule" of W8LUT and W4BBL. These fellows used to have a regular weekly sked on 75 'phone. When the closedown came, instead of giving up the sked they continued it, via records. Each week they mail each other a disc on which they've recorded the latest dope, and it's almost as much fun as over the air. Useful, too; each has a finger in the WERS pie in his particular locality, and they've exchanged a lot of pointers in this way with mutual profit.

Apart from the business of keeping ham spirit alive by exchanging recordings in lieu of chewing the air on 75, there are some interesting technical possibilities, too. There are a lot of tricks to be tried in recording. How about a simpler way of making "dupes" than by master matrixes and pressings, for example? Maybe one of us will pop up with one of those screwy ham ideas that may or may not turn out to have a handle on it, as TOM used to say. Here's a letter from Les Yoder, W3EED, along that line:

> . . . Plenty of our brother hams are also amateur photographers. Let's combine these two swell hobbies and record some sound on film. There are plenty of 8 mm. cameras available and they could easily be converted for this purpose. Here's hoping to hear from you on this or reading all about it in a future issue of *QST*.

We hope, too, that some day you'll be reading something about that subject in *QST*, Les. We haven't much to offer on that subject ourselves, but possibly some of the brethren have had experiences they would be willing to pass along. How about it?

Meanwhile, there's a letter in the file from J. P. Arndt, Jr., of the Brush Development Co., that must be mentioned. In it, he points out a misinterpretation that might arise in connection with one of the statements in the August article on recorders. Quoting Mr. Arndt:

> . . . On page 57 . . . you have said that "The stylus in a crystal cutter is actuated by the mechanical deformation or twisting tendency of a thin, elongated *section* of piezoelectric crystal when electrical voltage is applied to it." This might be taken to mean that a single section of crystal is employed in the cutter. Actually, all crystal cutters that have been put on the market to date employ multi-layer or "Bimorph" crystal elements ("Bimorph" is a registered trade mark of the Brush Development Company. . . . A single plate or Rochelle salt crystal does not have any tendency to twist upon application of a voltage to its electrodes. Its only tendency is to deform by elongation or contraction (expander plate) or by executing a shearing motion (shear plate). A twister "Bimorph" is made by cementing together two or more shear plates with such orientations that the shearing tendencies are in opposite directions. Since the plates are cemented together, they oppose each other and a twisting couple results. . . .

That lucid explanation should clear up the matter completely. Now to the main topic for

*Executive Editor, *QST*.

discussion — miscellaneous testing and trouble-shooting methods.

Checking Frequency Characteristics

One of the questions that arises in connection with the discussions of frequency characteristics, equalizers, etc., which appeared in preceding installments is a means of checking to make certain that the desired results are achieved.

This is none too easy, at best. A check of a sort can be had by feeding the recorder-amplifier input with a variable-frequency tone source and observing the output on an a.f. voltmeter connected directly across the cutter. This can be extended to include the complete recorder and playback system by feeding the tone source into the playback amplifier and using a small portion of its output to drive the recorder amplifier.

Such a procedure shows up faults in the amplifier characteristic well enough, but discloses nothing about the pickup or cutter — which are, after all, the elements of the system about which we want most to know. A step forward will be taken if one of the standard frequency-test records now commercially available is used for the variable-frequency tone source. These records deliver a series of standard tones at regular frequency intervals with constant output, and, when reproduced through the regular playback pickup and amplifier, show the characteristic of the system as a whole.

To make the check fully complete, however, the cutter should be made to cut an actual record. Of the several ways that might be used to check this end-product of the system, one has been generally accepted as standard because of its comparative simplicity and accuracy — the optical method.

This method consists of visual observation of the "light-diffraction" pattern made by reflected light shining in the grooves, from a source which casts its rays obliquely across the record. All that is needed is a light bulb, the record and an eye. The general set-up is shown in Fig. 1.

A typical example of the resulting pattern seen by the eye is illustrated in Fig. 2. The width of the light area of the pattern is proportional to the groove depth, or modulation amplitude. This is because the greater the ratio of modulated groove width to groove depth, the greater the band over which light is reflected. By measuring the width of this band at right angles to the radial axis, an exact quantitative measurement of the modulation amplitude can be obtained.

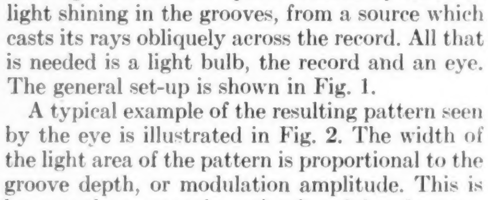


Fig. 1 — **Checking the frequency-response characteristic of a lateral recording by the optical method.**

An overall constant-amplitude characteristic with flat frequency response will appear as a straight-sided rectangle, while a modified constant-velocity characteristic with progressive high-frequency attenuation will look something like a Christmas tree — giving rise to the term "Christmas-tree pattern" sometimes applied to this method.

Making Optical Tests

In making such an optical check, a single light source of small area and high brilliance is desirable, although an ordinary 60-watt bulb will serve. The record should be placed on a low table, with the light source 6 or 8 feet to the left and a foot or two above the record. Standing erect, look down on the record with the eye directly above the pattern (using the side nearest the light). Proper placement of the light source is essential to secure bands with square ends which can be accurately measured.

Standard procedure in making the frequency run for an optical test record is to begin first with a 1000-cycle reference frequency, and then record successive tones (from a constant-output audio oscillator) ranging from 30 or 50 cycles up to 7500 or 10,000 cycles, depending on the probable maximum range of the system. The test is then terminated with another 1000-cycle reference cut. Professional recording engineers also cut the 1000-cycle reference tone at its proper sequence in the actual run, using three levels — first the reference level, then 2 db. lower and finally 2 db. higher. Measurement of the linear variation in the pattern width at these points then gives data for a directly-measured db. calibration. The amateur, however, is probably best advised to measure the total width of each band and establish an overall curve. This will be in terms of voltage, and can of course be converted into db. by reference to the voltage scale on a db. chart of *Lightning Calculator*.

With this data as a basis, equalization can be applied to correct faults in the curve and provide any recording characteristic desired.

If a pattern with an overall variation of not more than 5 db. from the theoretical ideal is secured, the results can be considered satisfactory. Under 2 db. variation would be well-nigh perfection. Such a characteristic can be achieved only by very careful equalization, and even then will vary as the stylus wears or with the disc material.

Considerable care is necessary to secure accurate measurements at frequencies below 500 cycles, particularly with a modified constant-velocity characteristic where the amplitudes become very low. Making each band of sufficient

duration (or length, in terms of recording time) will help. Typical practice is to record each tone for 10 seconds with 5-second intervals in between.

A pattern that is unsymmetrical around the radial axis indicates a variation in the depth of cut, or vertical modulation as well as lateral. The width of the pattern in the unmodulated condition (when no tone is applied) is an index of the residual noise in the amplifier (chiefly hum).

Other Optical Checks

Apart from its use in frequency-response analysis, a number of other interesting checks can be made by optical inspection. One of these is a check on groove-wall smoothness by comparison of the two patterns on opposite sides of the record. Since the pattern nearest the light results from reflection from the outer groove wall and that on

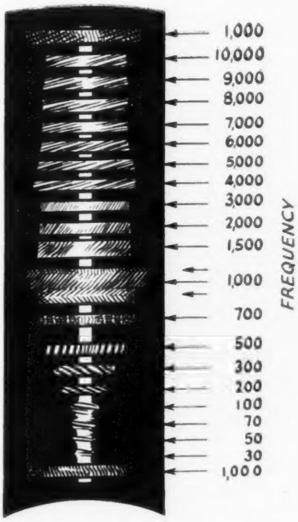


Fig. 2 — **Appearance of a typical light pattern as seen on a test record. Figures represent test frequencies.**

the farther side from the inner groove wall, any appreciable difference between the two indicates an unsymmetrical groove, caused by a worn or improperly-ground stylus. This will be indicated also if the pattern appears to change if the eye is moved along the radial axis of the record. With well-cut grooves made by a sharp stylus the pattern will be bright and well-defined, while rough grooves — causing high surface noise, distortion and playback-stylus wear — produce a dull, indistinct pattern.

Further clues to recorder imperfections can be obtained by inspecting the record as a whole under direct light. A perfect recording will display a smooth, even texture over its entire surface. Its pattern will be symmetrical, sharp, bright and shiny. Imperfect recordings display the following symptoms:

1) An appearance of irregularity in groove spacing, so that they appear to group in bunches, indicates a sloppy feed mechanism. Large "jumps" or land areas may be caused by tangled chip threads pulling the cutter.

2) Recurrent patterns in the form of spokes (alternate light and dark areas) indicate a defect in the motor-drive system, usually worn pulleys or bearings. They are especially likely to occur with a heavily-loaded motor.

3) Recurrent patterns in the form of sharply curved spokes or arrowheads (Vs) usually indicate vibration, either in the turntable mounting itself or transmitted to it by the motor-drive coupling.

4) Small Vs of rapid recurrence distributed over the face of the record may indicate excessive hum in the amplifier. This occurs most often in inexpensive recorders, where the hum is masked in playback by the lack of low-frequency response in the system.

5) "Skip" patterns, occurring on only one radial line on the disc, indicate a defective blank — either a bent or dented base or a swirled coating. Throw that one away and start over!

6) An erratic, "spotted" pattern, with small alternate light and dark strips resembling a condensed code tape, results from bad chatter, attributable to the cutting head. It may be caused by a poor stylus or one set at a wrong angle, or by insufficient vertical damping. Too deep a cut in a thin coating may also produce a similar effect.

Bouncing and Flutter

Such patterns on the record all result from *vertical* movement of the cutting head — as opposed to the horizontal movement of the stylus under modulation. And one of the basic rules, it will be recalled, is that in lateral recording all motion must be confined to the horizontal plane and there must be no vertical movement.

The vertical oscillations — variously called "flutter" or "bouncing" — which produce these regular patterns are of relatively low frequency (usually in the vicinity of 30 c.p.s.). They are undesirable both in that they cause harmonic distortion in the lateral groove and also because they modulate the surface hiss, raising the residual noise level.

These oscillations may arise from a variety of causes. One of the most common is a mechanical resonance produced by the mass of the cutting head in combination with the stiffness of the record material. If a spring-type counterbalance is used in the cutter arm it may accentuate the condition. The cure is to add a good vertical damper, preferably of the oil-dashpot type. Lacking that, using a shallower cut or adjusting the counterbalance may help to reduce the trouble.

Other causes of bouncing or flutter may be (a) an irregular record surface, as with a swirled coating; (b) an unbalanced turntable, resulting

either from uneven weight distribution or because the mounting isn't level; or (c) transmission of motor vibration through the turntable drive or suspension.

All in all, vibration is probably as bothersome a source of trouble in recording as there is. Vibration within the recording equipment itself is bad enough, but not infrequently the source is outside. Mechanical jars have spoiled many a recording. Building vibration, caused by traffic outside or even by persons walking within the house, may be responsible for a low-pitched rumble that defies indentification with any other source. Spring mounting of the turntable will assist in such cases if it actually damps the motion instead of accentuating it, as may be the case if the springing is not correctly designed for the actual loading encountered.

Wows

Variations of still lower frequency, or "wows," are not as likely to show up in the form of visible patterns, unless they are associated with vertical vibrations. They will, however, be apparent on playback as a wavering of pitch. If the waver is of a regular recurrent period identifiable with the speed of turntable rotation, it is probably associated with the turntable drive system — slippage due to a flat pulley or an eccentric rim or even a spot of oil on a pulley in the case of rim-pulley drives, or a worn gear section or loose set-screw. Occasionally a worn bearing will do it, too, particularly if there is side-thrust, although worn bearings more often result in an intermittent waver. Insufficient tension on drive or idler pulleys will also cause an intermittent waver.

Other causes of "wow" may be record slippage, where no turntable "hold-down" device is employed or the center hole is oversized; warped records; a warped or out-of-round turntable, or excessive vertical damping.

A less likely source of trouble, but worth checking if no other cause develops, is the feed mechanism. Binding due to worn or out-of-line bearings may cause low-frequency lateral variations of sufficient amplitude to be bothersome.

Except from the evidence of performance, there is no very easy method of analyzing "wow." A stroboscopic card may help to show up severe cases by appearing to oscillate, or slow down and speed up, although this is often difficult to distinguish from an actual drift in speed.

Blanks

The importance of properly caring for and handling blanks cannot be too heavily stressed. The professional goes to extremes that may seem ridiculous to the home recorder — but the latter's records would sound better longer if he used a little more of the same care.

The discs should always be stored in an envelope — vertically, on edge, and preferably in a cool, dry, dust-free place — and the recording surface itself never touched by hand. A recording disc's two greatest enemies are dust and fingerprints. Both cause a rapid rise in surface noise. Some fanatical devotees even make a practice of wearing silk gloves whenever handling records — a lot of trouble, perhaps, but worth it.

If dust does accumulate on a record it should be cleaned thoroughly before being played, so that the abrasive action under the playback stylus does not wear the groove. A brush should never be used to clean the record — and above all don't use cleaning compounds. The best way is with compressed air or a hard stream of cold water, the easiest to wash the record with tap water under a faucet and dry it with a lint-free cotton cloth. The transcription studios use an imported English cloth called "svelte" which sheds no lint whatsoever.

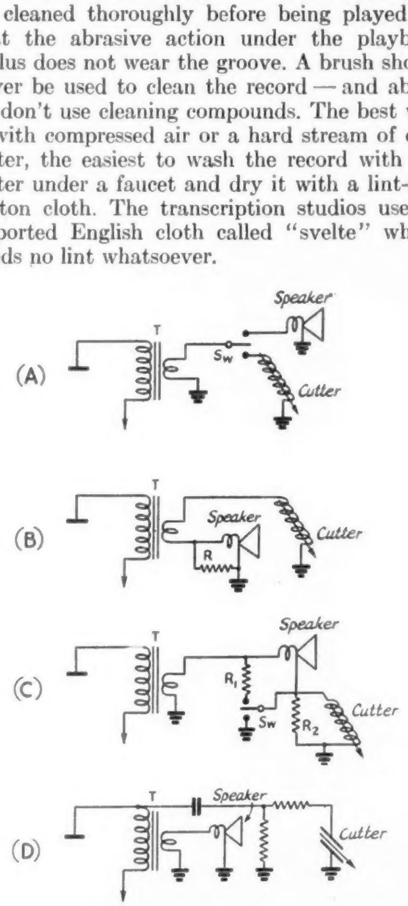


Fig. 3 — Representative monitoring systems.

(A) Simple switching circuit for a magnetic cutter. Speaker voice-coil impedance should be the same as that of the cutting head.

(B) Series circuit for simultaneous monitoring with a magnetic cutter. R is adjusted to produce comfortable volume level in the speaker. Output-transformer secondary load is equal to the total impedance of the cutting head in series with the parallel combination of the voice coil and R. The amplifier should have ample reserve power to supply the speaker as well as the cutter.

(C) Series circuit with switching, for use when amplifier is used both for recording and playback. R_1 is adjusted for desired monitoring volume. R_2 may be one to three times cutter impedance, depending on amplifier power capability.

(D) Simultaneous-monitoring circuit for a crystal cutter, using speaker output-transformer primary for coupling choke. Shunt resistance may also be used to reduce speaker volume and stabilize loading. For other values, see Fig. 5-D, p. 71, September, 1942, *QST*.

The reason dust is so great a problem is because the record coating develops a charge of static electricity during cutting which causes the particles to adhere very closely, increasing the abrasive action and resisting all ordinary methods of cleaning, such as brushing. In fact, brushing builds up the charge and makes matters worse. Static seems to be particularly bad with the new glass-base "priority" records; for this reason, some types now have a fibre insert for the center hole to counteract the building up of a charge.

The static charge is additionally troublesome during the cutting process in that it makes the thread difficult to control, the chip tending to fly up against the head, causing tangling unless an effective chip wiper is used.

The strength of the static charge is evidenced by tests made at NBC, which showed that rubbing a transcription disc with felt created potentials as high as 12,000 volts. Merely withdrawing the disc from its envelope set up charges as high as 5000 volts! If you have ever seen a transcription operator pick up a disc by its edges and hold it a moment before placing it on the turntable, this was for the purpose of draining off as much of the charge as possible.

Although now generally abandoned, the once fairly-common practice of lubricating or waxing the record to increase its playing life was a great liability as a dust-collector, too. Some commercial compounds — usually based on a solution of carbon tetrachloride in which a little paraffin is dissolved — are still available, but the experts avoid them. While their use may add a few playings to the record life, they increase the initial surface noise and greatly add to the dust problem.

While we're on the general subject of recording discs, this is probably as good a place as any to emphasize that almost any of the standard commercial blanks, even of the cheaper home-recording variety, is capable of making a decent recording. It's something of a habit to blame inferior results on the blank, but usually the fault lies somewhere else — vibration, stylus angle, depth or shape of cut, and so on.

Of course, the blank should have been properly stored so that it is not warped or chipped when the time comes for use. It should have been kept at normal room temperature — neither too hot nor too cold. It should be used within a reasonable time after manufacture so that the coating will not have dried out too thoroughly — especially if it is of the "soft" variety for which exceptionally-low noise level is claimed.

The most direct check on the condition of the blank is by examination of the chip. Like the finished record surface, the thread should be bright and shiny, like a finely-made, flexible chain which will lie straight without curling. A dull chip, especially one that breaks off and curls into short loops, *may* indicate an overly-dry or aged blank. It may also indicate a dull stylus, however — so first make sure that the stylus isn't at fault.

Transcription operators make a practice of checking blanks by making an unmodulated test cut at the outer edge of the record, outside the normal playing area. They then listen to this cut with the playback amplifier wide open and note the noise level on the output meter. If it falls below a pre-determined maximum and the chip looks all right, they use the blank; if not, they try another.

If the home recordist proposes to use this method of checking blanks, however, he should first make sure that the balance of his equipment is in perfect — and always identical — condition. It is well to keep on hand one cutting and one playback stylus, each in perfect condition, solely for this purpose — so that a blank won't be convicted of a high noise level when actually it is a dull stylus that is guilty.

Temperature Effects

Although of lesser virulence than dust and fingerprints, temperature and humidity may also be dangerous enemies of the recorder. Their effect on the blank — both in storage and during cut-

(Continued on page 88)

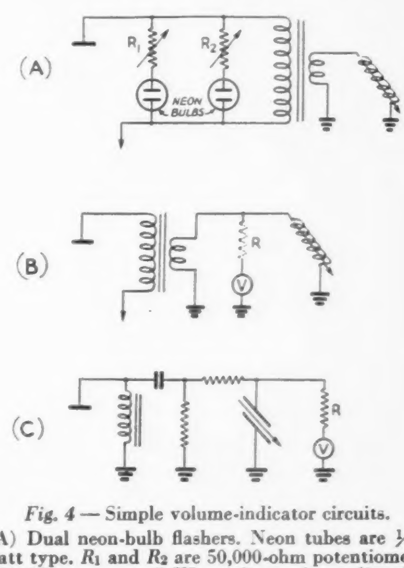


Fig. 4 — **Simple volume-indicator circuits.**

(A) Dual neon-bulb flashers. Neon tubes are ½- or 1-watt type. R_1 and R_2 are 50,000-ohm potentiometers.

(B) "Output-meter" VI, reading voltage directly at the cutter head. "V" may be either a copper-oxide or vacuum-tube voltmeter (r.m.s. type), calibrated in db. if desired. R is multiplier required to establish maximum range (if required).

Typical scale ranges suitable for various standard cutter impedances:

4 ohms —	2.5 volts
8 " —	4 "
15 " —	5 "
500 " —	30 "
5000 " —	100 "

(C) Use of a high-range a.c. voltmeter as a VI for a crystal cutter. R is the multiplier (150,000 ohms for 1-ma. copper-oxide milliammeter and 150-volt scale).

A Course in Radio Fundamentals

Lessons in Radio Theory for the Amateur

BY GEORGE GRAMMER,* W1DF

No. 7 — Receivers and Power Supply

The subject of receiving, the chief topic in this month's installment, is one for which a great many experiments could be outlined. Really comprehensive ones, however, would require far more elaborate equipment than has been used for the previous work. Simple experiments, such as the construction of small receivers or amplifiers, are highly beneficial to beginners and are strongly recommended to those who have never built any of their own receiving equipment. Various designs are available in the constructional section of the *Handbook*, and they can be copied as given or can have such variations introduced as the experimenter thinks desirable, based on his study of the text of Chapter Seven. However, the amateur of ordinary experience has already done these things, and unfortunately a repetition would be of relatively little value for our present purposes because no means is available to *measure* the results. Consequently the experiments to be outlined are based on the measuring equipment used in the previous experiments.

Those who are conducting radio courses will find it helpful to include a bit of simple receiver construction and also to work in an experiment which involves alignment of a superhet receiver of conventional design. In many formal courses it is likely that the requisite test equipment will be at hand. The details of such experiments are rather obvious and need no special comment.

Modulation Problem

Question 14, Assignment 21, is a practical problem and was therefore included in the form given, rather than being phrased in such a way that the answer could be read directly from the design chart in the section on cathode modulation. It can be solved by the trial and error method, but two answers are possible depending upon the initial assumptions.

The chart is based on continuous 100 per cent modulation with a sine-wave modulating signal. The "plate-modulation rating" referred to is consequently based on an average power input which is the sum of the carrier input and the modulating power; the power input is therefore 1.5 times the carrier input. The two tubes have a combined plate dissipation of 120 watts and the assumed efficiency is 77.5 per cent, so that the maximum permissible power input is 120/0.225, or 533 watts. Since this is the input with 100 per cent modulation, the carrier input will be 533/1.5, or 355 watts, and the carrier output will be 355×0.775, or 275 watts. These last two figures constitute the plate-modulation ratings.

At this point it is necessary to assume different values for m, finding W_{in} for each value and then applying the corresponding factor for W_a to W_{in} to see whether the required audio power turns out to be 80 watts, the amount specified in the question. The proper value for m is 59, when $W_{in} = 355 \times 0.77 = 273$ watts; $W_a = 273 \times 0.29 = 80$ watts (near enough). The carrier output is therefore $273 \times 0.65 = 176$ watts. The modulating impedance readily can be found, since the power input, plate voltage, and percentage of plate modulation are known.

The second basis assumes that it is safe to operate the tubes at rated plate dissipation under carrier conditions only, neglecting the increased dissipation when the power input increases with modulation. This is frequently done in amateur practice, where the voice modulation is not sinusoidal and the average increase in power input under modulation is quite small. In this case it is necessary to find a value of m which will make the plate dissipation 120 watts and require an audio power of 80 watts. On trying different values of m it is found that when m is 50 per cent the plate efficiency, N_p, is about 62 per cent, so that the carrier power input is $120/0.38 = 316$ watts. W_a at this point is 25 per cent of 316, or approximately 80 watts. The carrier output is therefore $316 \times 0.62 = 196$ watts.

1943 Handbook

The text of the 1943 *Handbook* can be used for this course equally as well as the 1942 editions. There is a slight difference in page numbering, but the section numbers are identical for the same subject material.

ASSIGNMENT 25

Study *Handbook* Chapter 6.

Questions

1) What are key "clicks"? Why are key clicks undesirable?

* Technical Editor, *QST*.

2) What is the cause of key clicks?

3) Name three requirements which should be met by a keying system.

4) What is a "back-wave"? What causes it?

5) What is meant by "break-in" operation and what are its advantages?

6) Name four methods of keying and draw simple circuit diagrams showing how each method is accomplished.

7) How does a lag circuit function in reducing key clicks? Describe a representative lag circuit.

8) Why is it frequently necessary to use an r.f. filter at the key?

9) Give the advantages and disadvantages of the following methods of keying: (a) center-tap keying; (b) plate keying; (c) blocked-grid keying; (d) power-supply keying.

10) What is a keying "chirp," and how is it caused?

11) In general, what is the effect of the ratio of voltage to current, in the circuit being keyed, on the required constants (L and C values) in the lag circuit?

12) What are the advantages of a vacuum-tube keyer circuit as compared to ordinary keying?

ASSIGNMENT 26

Study *Handbook* Sections 7-1 to 7-4, inclusive, beginning page 111. Perform Exp. 35.

Questions

1) Why is it necessary to "detect" radio signals?

2) What types of amplification are used in a receiver?

3) How can code signals be made audible in a receiver?

4) Name four types of receivers frequently used in high-frequency work.

5) What is meant by the sensitivity of a receiver?

6) How is the band-width of a receiver specified?

7) What determines the selectivity of a receiver?

8) How are selectivity and signal-to-noise ratio related in a receiver?

9) What is a selectivity curve?

10) Name some factors affecting the stability of a receiver. Define "stability" as the term is applied to receivers.

11) What is receiver fidelity?

12) Name the three most common types of detectors.

13) Draw a circuit diagram of a simple diode detector and explain the operation.

14) What is meant by the linearity of a detector?

15) Define sensitivity as applied to detectors.

16) Describe the operation of the plate detector. Why is the plate detector more sensitive than the diode detector? Why is it less sensitive than the grid-leak detector?

17) What is an infinite-impedance detector?

18) In what respect does the grid-leak detector resemble a diode detector? Describe the operation of the grid-leak detector and draw a representative circuit diagram.

19) Compare the diode, grid-leak, and plate detectors in the following respects: (a) sensitivity; (b) impedance; (c) linearity; (d) signal-handling capability.

20) What is a regenerative detector? Why is its sensitivity greater than that of a non-regenerative detector?

21) Draw a regenerative detector circuit of the tickler type, indicating audio-frequency output connections.

22) Name two methods of controlling feed-back in a regenerative detector circuit.

23) Describe the method of tuning a regenerative detector for both code and 'phone signals. What setting of the regeneration control gives greatest sensitivity?

24) Why does a regenerative detector have greater effective selectivity than a non-regenerative detector?

25) Why is the sensitivity of a superregenerative detector greater than that of an ordinary regenerative detector?

26) If a regenerative detector circuit exhibits hand-capacity (body-capacity) effects, what are the probable causes?

27) What is tunable hum, and how is it caused?

28) What is the purpose of the quench voltage in a superregenerative detector?

29) Why are "dead spots" likely to occur when a regenerative or superregenerative detector is coupled to an antenna?

30) Draw a representative superregenerative detector circuit with separate quench oscillator. How is the quench voltage produced in a self-quenching circuit?

ASSIGNMENT 27

Study *Handbook* Sections 7-5, 7-6 and 7-7, beginning page 118. Perform Exp. 36.

Questions

1) Why is audio-frequency amplification needed in a receiver?

2) What is the purpose of a "tone control"? Draw a simple tone-control circuit.

3) How is grid bias ordinarily secured for amplifiers used in receivers?

4) Draw a circuit diagram of a typical radio-frequency amplifier using a pentode tube. Show a method of controlling the amplification.

5) Why is it necessary to use screen-grid tubes in r.f. amplifiers?

6) What precautions must be taken to prevent self-oscillation in the r.f. amplifier stage?

7) What is thermal agitation noise? Upon what factor does its value depend in a tuned circuit?

8) What is the normal cause of noise originating in a vacuum tube?

9) What design considerations must be followed to secure a good signal-to-noise ratio?

10) What causes underlie the input loading effect? How is this effect related to frequency? What is its effect on the selectivity and gain of an r.f. amplifier?

11) Why is the first tube in the receiver the most important one from the standpoint of signal-to-noise ratio?

12) Why is it necessary to sectionalize the tuning range of a receiver into bands?

13) What is meant by "bandspread"? Describe three methods which may be applied to tuned circuits for accomplishing bandspreading. Give the relative advantages and disadvantages of each method.

14) Using circuit A, *Handbook* Fig. 712, what should be the capacity variation available in C_2 to spread the band 7000–7500 kc. over its tuning dial if the coil has an inductance of 10 microhenrys? At what value of capacity should C_1 be set to give this bandspread?

15) A coil having an inductance of 10 microhenrys is tuned by a condenser having a maximum capacity of 100 $\mu\mu$fd. If a bandspread condenser having a maximum capacity of 20 $\mu\mu$fd. and a minimum capacity of 5 $\mu\mu$fd. is shunted across the main tuning condenser, what tuning range can be covered with the bandspread condenser when the main condenser is set at 25 $\mu\mu$fd.? At 50 $\mu\mu$fd.? At 100 $\mu\mu$fd.?

16) The following values are used in the bandspread circuit of *Handbook* Fig. 712-B: inductance, 35 microhenrys; bandspread condenser, C_1, maximum capacity 200 $\mu\mu$fd., minimum capacity, 30 $\mu\mu$fd.; C_2, 50 $\mu\mu$fd.; C_3, 25 $\mu\mu$fd. What is the tuning range of the circuit?

17) Assuming that the capacity variation of C_1 in Q. 16 is linear with respect to dial settings, plot a curve showing the resonant frequency of the circuit as a function of the dial setting. (Assume a dial having 100 divisions.)

18) In *Handbook* Fig. 712-A, if the bandspread condenser, C_1, has a maximum capacity of 20 $\mu\mu$fd. and a minimum capacity of 5 $\mu\mu$fd., what capacity is required at C_2 and what inductance should be used in a tuned circuit which is to have bandspread tuning over the 3500–4000-kc. range?

19) Plot a curve showing resonant frequency as a function of dial setting for the circuit of Q. 18, assuming a 100-division dial and linear capacity variation in the bandspread condenser. Compare its shape with the graph of Q. 17.

20) What is meant by "tracking"? In the case of tuned r.f. amplifier stages, what requirements must be met for correct tracking?

21) How is it possible to compensate the effects of tube and stray capacities in circuits which are to be tracked?

22) Why does amplification with a given tube fall off at ultrahigh frequencies?

ASSIGNMENT 28

Study *Handbook* Sections 7-8 to 7-12, inclusive, beginning page 123. Perform Exp. 37.

Questions

1) Describe the operating principles of the superheterodyne receiver. Draw a block diagram showing the various sections of such a receiver.

2) What are the advantages of the superhet over other types of receivers?

3) What is image response? Name some other "spurious" signals that may be encountered in a superhet receiver.

4) A superhet receiver having an intermediate frequency of 455 kc. is to be adjusted to receive a signal on 13,540 kc. To what frequencies can the high-frequency oscillator be set to give a beat signal at the intermediate frequency? What will the image frequency be in each case?

5) What is a double superheterodyne? What is the purpose of this type of circuit?

6) What is the function of the first detector or mixer in a superheterodyne?

7) Define conversion efficiency as applied to mixers.

8) What is "pulling"? What requirements with respect to oscillator voltage should be met by a mixer?

9) Draw a circuit diagram of a typical mixer circuit, indicating the point at which oscillator voltage should be injected.

10) Why is it desirable to use separate mixer and oscillator tubes rather than to perform both functions in one tube?

11) What is meant by "tracking" in the case of gang-tuned mixer and oscillator circuits?

12) A mixer-oscillator circuit is to tune over a signal range of 4000 to 8000 kc. If the intermediate frequency is 455 kc., what frequency range must be covered by the oscillator if the oscillator frequency is to be higher than that of the mixer?

13) What requirements must be met by the high-frequency oscillator of a superhet receiver for optimum receiver stability?

14) Draw a representative oscillator circuit, showing the point from which injection voltage for the mixer may be taken.

15) What considerations dictate the choice of an intermediate frequency in a superhet receiver?

16) Describe the construction of an intermediate-frequency transformer. How are the gain and stability of the transformer affected by the types of coils and condensers used?

17) What is the "single-signal effect"?

18) Draw a circuit diagram of a typical intermediate-frequency amplifier. What precautions are necessary to prevent self-oscillation?

19) What benefits result from making an i.f. amplifier regenerative? What are the disadvantages?

20) Why does a properly-designed crystal filter greatly increase the selectivity of an i.f. amplifier?

21) What is the function of the "phasing condenser" in a crystal-filter circuit? Draw a typical crystal-filter circuit, indicating the phasing condenser and the selectivity control.

22) What is the function of the second detector in a superhet receiver? What type of detector is commonly used?

23) What is the purpose of the beat-frequency oscillator? What design considerations are necessary to prevent its causing spurious responses in the receiver?

ASSIGNMENT 29

Study *Handbook* Sections 7-13 to 7-17, inclusive, beginning page 131.

Questions

1) Show by a simple circuit how voltage for automatic volume control can be secured from a diode detector and applied to the control grids of r.f. amplifiers. Indicate filter circuits. Describe the operation of the circuit.

2) What is meant by "delayed a.v.c."?

3) What considerations determine the selection of the time constant for the a.v.c. filter circuit? What is the effect if the time constant is too small? If too large?

4) What is the purpose of a tuning indicator? Draw a representative circuit and describe its operation.

5) Name two advantages resulting from the use of tuned r.f. amplification preceding the mixer stage in a superhet receiver.

6) What are the advantages and disadvantages of regeneration in a preselector stage?

7) Describe the general principle upon which devices intended to reduce impulse noise operate.

8) What is a noise limiter? Why are such devices most satisfactory when used in receivers having a comparatively broad resonance curve?

9) Outline the differences in operating principles between a limiter of the type used with second-detector circuits and the i.f. noise silencer.

10) What is the proper method of setting the frequency of the beat-frequency oscillator in a superhet receiver? Why should the b.f.o. not be tuned exactly to the intermediate frequency, especially when a crystal filter is used?

11) How is it possible to recognize an image signal in a superhet receiver? How can other spurious responses be identified?

12) Describe the general method of aligning the intermediate-frequency amplifier of a superhet receiver, using a test oscillator.

13) In aligning the r.f. to the mixer stage in a superhet receiver it is found that, after resonating the r.f. stage at the high-frequency end of the range by means of the trimmer condenser, on tuning to the low-frequency end of the range the r.f. trimmer capacity must be reduced to obtain maximum response. If the tuning condensers in the two stages are identical, what must be done to bring about proper tracking?

14) How does oscillation in r.f. or i.f. circuits manifest itself? Name some possible causes and remedies.

ASSIGNMENT 30

Study *Handbook* Section 7-18, beginning page 139. Perform Exp. 38.

Questions

1) In what way does a receiver for frequency modulation differ from one for amplitude modulation?

2) What is the function of the limiter in an f.m. receiver?

3) Why is it necessary to have a great deal of r.f. gain in the part of the receiver preceding the limiter?

4) What is a "cascade" limiter? What is its advantage over an ordinary limiter?

5) Draw a simple limiter circuit and describe its operation. In what respects does the operation of the circuit differ from that of an r.f. amplifier?

6) Compare the requirements for the detection of frequency-modulated signals with those for amplitude-modulation detection.

7) Describe briefly the operation of the ordinary type of f.m. detector or "discriminator."

8) What factors determine the frequency range over which a discriminator circuit will give linear response?

9) How can it be determined that the limiter circuit of an f.m. receiver is functioning properly?

10) Describe a method of adjusing a discriminator circuit for proper operation.

ASSIGNMENT 31

Study *Handbook* Chapter 8. Perform Exp. 39.

Questions

1) Define voltage regulation.

2) Why is it necessary to use direct current for the plate supply for vacuum tubes?

3) Compare high-vacuum rectifiers and mercury-vapor rectifiers as to voltage drop.

4) Define (a) inverse peak voltage; (b) peak plate current.

5) What is "arc-back"? What causes it, and how may it be prevented?

6) Name three types of tube rectifier circuits in common use.

7) Draw a circuit diagram of a full-wave center-tap rectifier and explain its operation. For the same output current and voltage, how does this circuit compare to the half-wave rectifier in the following respects: (a) inverse peak voltage on rectifier tubes; (b) tube current; (c) transformer secondary voltage required; (d) output wave-shape; (e) power taken from transformer.

8) Draw the circuit of a bridge rectifier and describe its operation. Compare to the center-tap rectifier on each of the points given in Q. 7.

9) Why is it necessary to use a filter with a rectified a.c. power supply?

10) What is ripple voltage? Define per cent ripple.

11) What order of per cent ripple is considered satisfactory for communication by c.w. and 'phone?

12) What is a bleeder resistance? For what purpose is it used?

13) What is the difference between a "choke-input" filter and a "condenser-input" filter?

14) Why is it necessary to use an air gap in the core of a filter inductance which is to carry direct current?

15) What is the ripple frequency of a full-wave rectifier operating from 60-cycle supply? From 25-cycle supply?

16) How does the d.c. output voltage of a condenser-input filter compare, at light loads, to the a.c. voltage applied to the rectifier?

17) Draw a circuit diagram of (a) a single-section condenser-input filter; (b) a two-section condenser-input filter. What values of inductance and capacity would be typical for the load resistances ordinarily encountered in practice, if the supply is designed to deliver direct current to the plate circuit of a vacuum tube or tubes?

18) Draw circuit diagrams of one- and two-section choke-input filters. What requirements must be met by the input choke to assure proper operation of the filter?

19) What is meant by "critical inductance" and "optimum inductance"? What are the advantages of a "swinging" choke?

20) Compare condenser- and choke-input filters in the following respects: (a) d.c. output voltage, for a given rectified a.c. voltage; (b) output voltage regulation; (c) rectifier tube peak current.

21) Why is it necessary to avoid resonance effects in the circuit formed by the input choke and the first filter condenser?

22) A two-section choke-input filter is to be designed to have 0.1 per cent ripple with an output of 1000 volts at 200 milliamperes. If the bleeder resistance is permitted to dissipate 10 per cent of the output power, what resistance is required, and between what inductance limits (minimum) should the swinging input choke vary from the bleeder load only to full load? If a smoothing choke having an inductance of 10 henrys is available, what capacity is required in each condenser, assuming that both have the same value, to give the required smoothing at full load?

23) What approximate output voltage will be obtained from a power supply having a transformer delivering 1100 volts each side of the center-tap (at full load), using mercury-vapor rectifiers, through a two-section choke-input filter when the filter inductances have resistances of 150 and 200 ohms, respectively, if the load current is 250 milliamperes?

24) If the rectifier and filter of Q. 23 are to be used in a power supply delivering 250 ma. at 1000 volts, what is the transformer voltage required? What is the output volt-ampere capacity required? Allowing 1000 circular mils per ampere, what size wire would be suitable for the transformer secondary?

25) Name two methods which may be used to stabilize the output voltage of a power supply when it is necessary to have the best possible voltage regulation for low-voltage circuits.

26) Why is it possible to use a tube containing gas at low pressure for the purpose of voltage regulation? Describe the operation of a regulator circuit using such a tube.

27) Explain the operating principles of the electronic voltage regulator.

28) What is meant by the term "protective bias"?

29) What are the requirements for a bias supply intended to furnish operating bias?

30) A voltage divider is to be used with a power supply to furnish the following voltages and currents to a receiver: 100 volts at 20 milliamperes, 250 volts at 35 milliamperes, and 325 volts at 75 milliamperes. If the output voltage of the supply is 325 volts when the current is 140 milliamperes, what resistance is required in the voltage divider and how should it be distributed between the taps? What power will be dissipated in the resistor?

31) What is the principle of a voltage-doubling circuit?

32) Draw a circuit diagram of a vibrator power supply using a tube rectifier. Explain its operation.

33) What is the function of the buffer condenser in a vibrator power supply?

34) What is the difference between synchronous and non-synchronous vibrators?

35) What precautions must be taken when mercury-vapor rectifiers are to be operated in parallel?

EXPERIMENT 35

Detector Operation

Apparatus: The power supply, oscillator, v.t. voltmeter, test instrument, tube board and circuit board are required for this experiment, together with an assortment of fixed condensers and resistors. The wiring diagrams for the three types of detectors tested are shown in Fig. 1. The oscillator may be operated either crystal- or self-controlled, with the plate voltage set to a low value so that the r.f. output will be small. Use the lowest tap on the power supply and adjust the output voltage by means of the variable resistor in the supply.

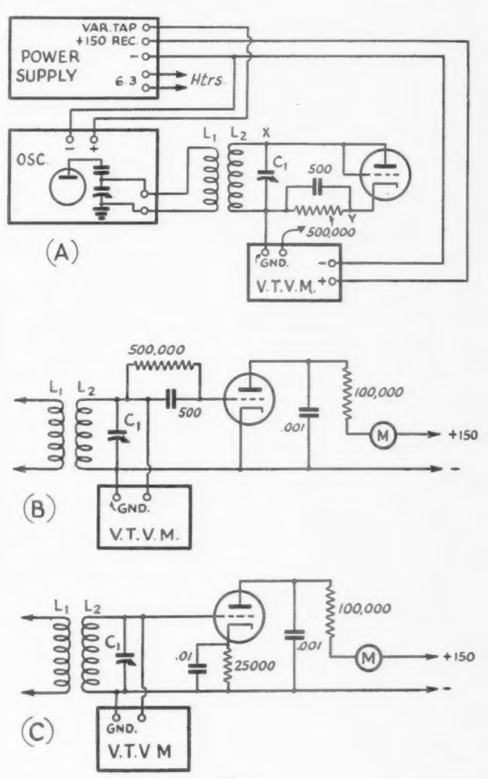


Fig. 1

The coils L_1 and L_2 are the movable and fixed coils, respectively, on the circuit board. Use 25 or 30 turns, as required for tuning to the frequency selected. A frequency of about 3 megacycles will be satisfactory if the oscillator is operated self-controlled. C_1 is the 250-$\mu\mu$fd. condenser associated with the fixed coil on the circuit board.

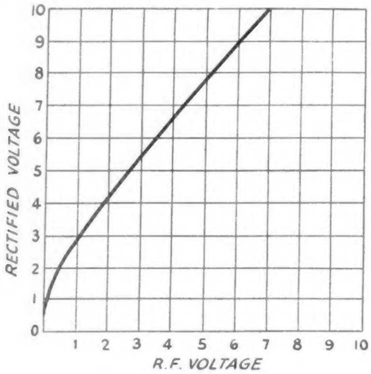


Fig. 2

Procedure: The object of this experiment is to compare the sensitivity and linearity of the diode, grid-leak and plate detectors. Connections for determining the diode characteristic are shown in Fig. 1-A. The tube may be any type having a diode section (such as the 6H6, 6R7, 6Q7, etc.) or a small triode such as the 6J5 with grid and plate connected together. The latter is indicated in the circuit diagram. The v.t. voltmeter is used to measure both the applied r.f. voltage and the rectified output voltage. For the former purpose the "hot" lead is connected to point "X" and for the latter to point "Y." While the output voltage could be measured by means of a d.c. microammeter inserted in series with the 500,000-ohm load resistor, the current is too small for accurate measurement with the ordinary test kit.

The value of the by-pass condenser across the load resistor is not critical, since the measurements are not being made at audio frequency. Although a 500-$\mu\mu$fd. condenser is indicated in the diagram, a larger condenser may be used if more readily available.

Set the oscillator plate voltage at 15 or 20 volts, couple L_1 and L_2 loosely together, and, with the v.t.v.m. connected to "Y," adjust C_1 to resonance. Resonance will be indicated by maximum v.t.v.m. reading. Use the low range of the v.t.v.m. and adjust the coupling between L_1 and L_2 (and, if necessary, the oscillator plate voltage) to give a reading corresponding to about 10 volts, as shown by the v.t.v.m. calibration curve. Shift the v.t.v.m. lead to "X" and note the reading. When the shift is made it will be necessary to retune C_1 to resonance, since the input capacity of the v.t.v.m. is now added across the tuned circuit. The r.f. voltage as read by the v.t.v.m. may be smaller than the d.c. output voltage; this may result from the fact that the v.t.v.m. loads the circuit slightly and consequently decreases the r.f. voltage, and also because the readings do not represent peak values. For the purposes of the experiment the absolute values of r.f. voltage are not especially important so long as the relative values are correct. Consequently the d.c. calibration of the v.t.v.m. can be used for reading r.f. voltage.

After setting the r.f. voltage to give an initial d.c. output of about 10 volts, reduce the voltage in small steps, taking readings of both r.f. and d.c. voltage, until the r.f. voltage is reduced to zero. It will be satisfactory to take readings at intervals of about 1 volt. Plot the rectified voltage as a function of r.f. voltage, as shown in Fig. 2. The resulting curve should be practically a straight line, except when the r.f. voltage is quite low. This curvature is exaggerated by the conditions of the experiment, since the v.t.v.m. loading on the tuned circuit makes the r.f. voltage readings low compared to the corresponding d.c. output reading; that is, the r.f. voltage actually operating when the v.t.v.m. is connected to "Y" is higher than the value existing when it is connected to "X." This can be overcome by using two v.t. voltmeters, or by leaving the v.t.v.m. connected permanently to "X" and measuring the current in the load resistor by means of a microammeter. The error is not serious for the purposes of this experiment, but it should be realized that it exists. Because of it, the sensitivity of the diode (ratio of d.c. output voltage to r.f. input voltage) is measured to be higher than is actually the case.

Note that the d.c. output voltage does not drop to zero when the r.f. voltage is zero. This is the result of the fact that some electrons emitted from the cathode with relatively high velocity reach the diode plate even though the latter is not given a positive charge with respect to the cathode (see Exp. 21). In a receiving circuit the diode normally would be coupled to the following audio amplifier through a condenser, so that this steady voltage would not affect the operation of the following tube.

Connections for the grid-leak detector are shown in Fig. 1-B. In this case the v.t.v.m. is always connected across the tuned circuit. The grid leak and grid condenser are in the grid lead to the tube, cathode being grounded. The plate circuit is by-passed for r.f. by the 0.001-μfd. condenser (larger values may be used), and the plate voltage is taken from the 150-volt regulated tap on the power supply. The load resistor is selected to limit the plate current to the region of 1 milliampere with no signal, giving a plate voltage of well under 50 volts. The milliammeter is connected in the plate circuit as shown; the test kit may be used for measuring both plate current and v.t.v.m. current. In this case plate current readings are taken for various values of r.f. voltage from zero up to 9 or 10 volts. If the same milliammeter is used for the plate circuit as for the v.t.v.m., the plate circuit of the detector should be closed when the instrument is connected to the v.t.v.m.

On plotting the data the curve showing plate current against r.f. voltage should have about the shape indicated in Fig. 3. As the r.f. or signal voltage increases the plate current decreases. This is because the bias on the tube is nearly zero with no signal, but rectification in the grid circuit develops a negative voltage between grid and cathode through flow of rectified grid current in the grid leak resistor. The greater the r.f. voltage the larger the bias developed, hence the plate current decreases with increased signal input.

The output voltage of such a detector is the change in voltage drop in the load resistor, just as in the case of an audio amplifier (see Exp. 23). It is, therefore, equal to the *change* in plate current multiplied by the load resistance. For example, in Fig. 3 the plate current is 1.11 ma. with 4 volts r.f.; this value subtracted from the plate current at zero r.f. voltage, 1.3 ma., is the change ($1.3 - 1.11 = 0.19$ ma.) in plate current caused by a 4-volt signal. The output voltage is therefore $0.00019 \times 100{,}000$, or 19 volts. Other points on the output voltage curve are found similarly. Notice that the curve has no really straight portion, and

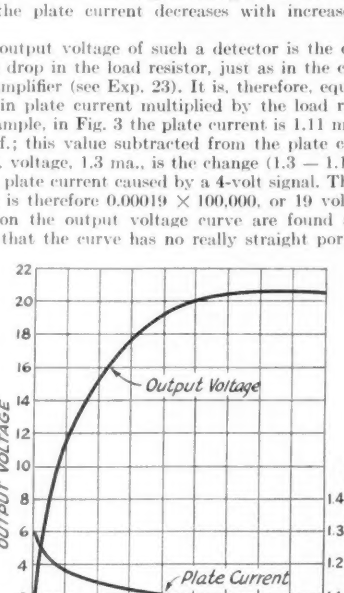


Fig. 3

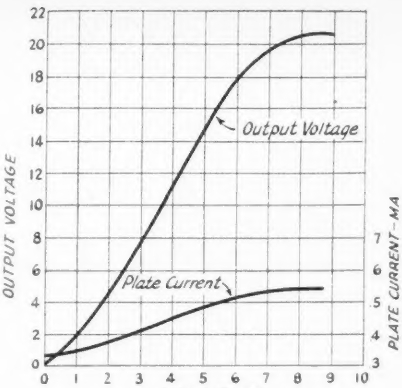


Fig. 4

that at high signal levels it flattens off, so that with more than a 6-volt signal there is no further increase in output.

The set-up for measuring the plate detector is shown in Fig. 1-C. It is similar to that for the grid-leak detector, but the tube is biased by means of a 25,000-ohm cathode resistor. The by-pass condenser in this case is 0.01 μfd., but somewhat smaller or larger values may be used. The measuring procedure is the same as with the grid-leak detector. In this case the plate current is quite small with no signal (that is, the tube is biased nearly to the cut-off point) and as the signal voltage is increased the plate current increases. If the same instrument is used both for measuring detector plate current and v.t.v.m. plate current, it is important that the plate circuit of the detector be closed when the meter is connected to the v.t.v.m. If this is not done there will be no plate current and consequently no bias, hence current will flow in the grid circuit of the tube and the r.f. voltage measurements will be incorrect because of the load on the circuit.

The data secured should be plotted as shown in Fig. 4. The output voltage is found by calculating the change in voltage drop across the load resistor by the same method used in Fig. 3. The output voltage curve should be fairly straight except near the upper end. The flattening off at the upper end is the result of several effects. Increasing plate current increases the voltage drop in the cathode resistor, and hence increases the negative bias on the grid; also, as the plate current becomes larger the voltage between plate and cathode becomes smaller because the drop in the 100,000-ohm load resistor increases. In addition, if the r.f. voltage becomes large enough the grid will be positive with respect to the cathode at some part of the cycle, causing grid current to flow. Such grid current causes an increase in the voltage drop across the cathode resistor, further increasing the negative bias. All these effects cause the plate current curve to flatten off when the signal voltage becomes too high.

In all of the detectors the actual audio-frequency voltage would be given by the variation in output voltage, as shown by the curves, about a mean voltage representing the carrier output. For example, in Fig. 4 assume that the incoming unmodulated carrier has an amplitude of 3 volts. This would cause a change of 8 volts across the load resistor, but since this change is constant so long as the carrier is present there would be no audio-frequency output — simply a shift in d.c. plate voltage at the tube. However, with 100 per cent modulation the carrier voltage would vary from zero to twice its unmodulated value, or from zero to 6 volts. The output voltage as shown by the curve would vary correspondingly from zero to 18 volts. Since the carrier is represented by an output of 8 volts, the "negative" swing of the audio-frequency output voltage would be from 8 volts to zero, giving a negative peak of 10 volts, and the "positive" swing would be from 8 to 18 volts, giving a positive peak of 10 volts. The fact that the positive and negative peaks are not equal indicates that distortion is introduced by the detector. If the modulation is reduced to 50 per cent, with the same 3-volt carrier, the r.f. voltage varies between 1½ volts and 4½ volts. The corresponding output voltages are 3.2 and 13 volts, giving negative and positive audio voltage peaks of $8 - 3.2 = 4.8$ volts and $13 - 8 = 5$ volts, respectively. The two peaks are more nearly alike in this case, indicating much smaller distortion. It is generally true of a detector that the distortion becomes larger as the modulation percentage is increased. So long as the carrier is not of such amplitude that the upper modulation peak falls in the flattened region at the top of the characteristic, the distortion is principally caused by the curvature near zero signal. The higher the percentage of modulation the more nearly does the instantaneous r.f. voltage approach zero on the down-peak, regardless of the carrier strength. The diode and plate detectors have longer linear sections to their characteristics than the grid-leak detector does; the latter is not really straight at any part, and becomes badly curved with signals of more than a fraction of a volt.

The sensitivity of the detector is given by the slope of the characteristic (volts output divided by r.f. volts input) at the value of carrier voltage considered (see introduction to Installment 4 for discussion on the slope of a curve). In Fig. 3 the slope is quite high at small signals, indicating that the sensitivity of the grid-leak detector is high. Comparing the three curves shows that the diode detector is the least and the grid-leak detector the most sensitive, with the plate detector intermediate.

Curves taken by the method given in this experiment do not hold exactly for the case of a modulated carrier, since the behavior with an a.c. output voltage will depend upon the effect of the by-pass capacities while these capacities do not affect d.c. measurements. For example, the grid bias in the case of the plate detector will not ordinarily follow the variations in the modulated carrier because the cathode by-pass condenser shunts the variations in plate current around the cathode resistor; only the steady carrier voltage is effective in determining the grid bias under operating conditions. The d.c. method is satisfactory for indicating the type of operation to be expected, however, and is adaptable to simple measuring equipment.

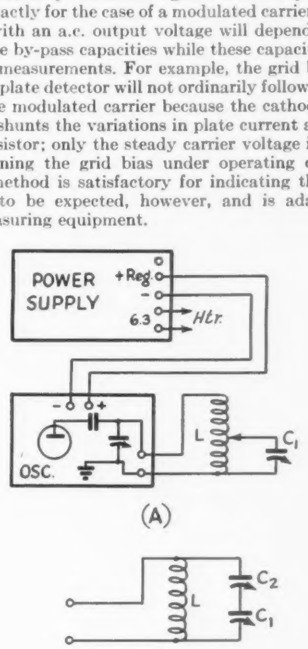


Fig. 5

EXPERIMENT 36

Characteristics of Bandspread Methods

Apparatus: The equipment required for this experiment includes the plate power supply, oscillator, coils and condensers from the circuit board, and a calibrated receiver. The oscillator is operated self-controlled, using the grid coil instead of the crystal. The regular plate coil is taken out of its socket and one of the tapped coils from the circuit board substituted, as shown at *L* in Fig. 5. The oscillator tank condenser should be connected across 25 turns of the coil.

Oscillator plate voltage may be taken from the regulated tap, using a VR-105-30 regulator tube. However, voltage regulation is not essential, so that the plate voltage can be

taken from one of the divider taps on the power supply, keeping the voltage at about 100 volts or less.

Procedure: Connect one of the variable condensers on the circuit board across the 25 turns in use at L, as shown in Fig. 5-A, where the condenser is designated as C_1. Set C_1 to minimum capacity, adjust the receiver to 4 megacycles, and adjust the tank condenser in the oscillator unit until the signal is heard. It will be advisable to keep the receiver gain low because the signal probably will be quite strong. If the receiver is a superhet, care must be used in setting the oscillator frequency actually to 4 megacycles rather than to an image frequency or other spurious response point. The proper frequency will be the strongest signal heard as the oscillator tank condenser is turned. (As another check, the oscillator frequency may be measured with an absorption wave-meter, if one is available.)

When the proper setting of the oscillator tank condenser has been found, increase the capacity of C_1 by a small amount and measure the new oscillator frequency by means of the calibrated receiver. Continue increasing the capacity of C_1 by small steps, taking a frequency reading each time, until maximum capacity is reached. If the condenser has a 100-division dial it will be satisfactory to take readings at every 10th division. After the series of readings is completed, connect C_1 across 20 turns of the coil, set it at minimum capacity, and readjust the oscillator condenser to bring the frequency to 4 megacycles. Increase the capacity of C_1 in small steps as before, taking frequency readings. Continue this procedure with C_1 across 15, 10 and 5 turns, successively.

After a complete set of data has been obtained, plot a series of curves showing frequency against dial settings of C_1, one curve for each tap condition. A representative set of curves is shown in Fig. 6. The condenser used had a maximum capacity of 250 $\mu\mu$fd., with "straight-line wavelength" plates. Plates of other shapes (semicircular or "straight-line capacity," for example) would give curves of different shapes, although the end points would be the same for condensers having the same maximum and minimum capacity. Curves A, B, C, etc., represent C_1 connected across 25 turns, 20 turns, 15 turns, and so on. The effect of C_1 on the frequency range becomes smaller (band-spread increases) as the number of turns across which it is connected decreases. Practically any degree of band-spread can be obtained by proper choice of the number of turns across which the condenser is connected, even though the condenser capacity may be quite large.

In this system of bandspread the inductance acts like an autotransformer. If there were no magnetic leakage in the coil — that is, if all the flux set up by each turn cut every other turn of the coil — the capacitive reactance appearing across the whole coil due to the presence of C_1 across part of the coil would be equal to the reactance of C_1 multiplied by the square of the turns ratio. For example, with C_1 tapped across 10 turns of the 25-turn coil, the reactance would be multiplied by $\left(\frac{25}{10}\right)^2$ or 6.25. The higher reactance is equivalent to a correspondingly smaller capacity than is actually in use at C_1. This transformation gives a new value of capacity which can be considered to be simply in parallel with the capacity already across the coil. If the capacity in use at C_1 at a given dial setting is 50 $\mu\mu$fd., in the above example, the equivalent capacity in shunt across the whole coil would be 50/6.25, or 8 $\mu\mu$fd.

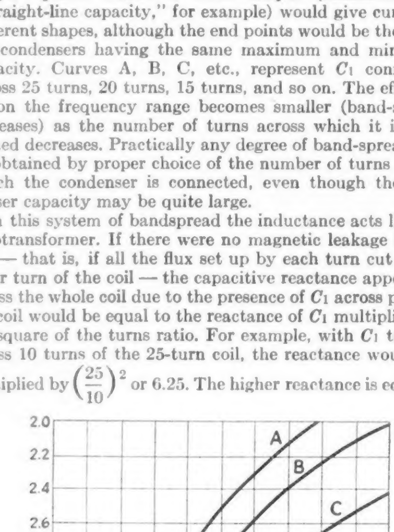


Fig. 6

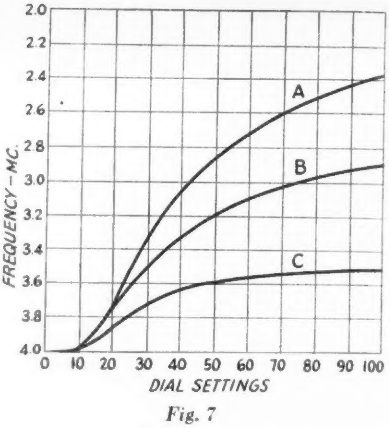


Fig. 7

In practice, this simple relationship does not hold because there is considerable magnetic leakage, so that the effective capacity of C_1 cannot readily be calculated from the turns ratio. In a general way, however, it indicates how the effect of the condenser can be expected to vary as the number of turns across which it is tapped is changed.

For the second part of the experiment, connect the two 250-$\mu\mu$fd. condensers on the circuit board in series across the 25-turn coil, as indicated at B in Fig. 5. Set the second condenser, C_2, at full capacity, adjust the oscillator tank condenser to bring the frequency to 4 megacycles, and take frequency readings for various settings of C_1 in the same way as above. Then set C_2 to half scale, reset the tank condenser to make the oscillator frequency 4 megacycles and repeat. Follow the same procedure for a third time with the series condenser, C_2, set at ¼ scale. (The last two settings of C_2 will not be ½ and ¼ maximum capacity, if the plates are not semicircular, but this will not matter for the purposes of the experiment.) Plot the data in the same way as in the first part of the experiment. Fig. 7 shows the results of such measurements, using condensers having "straight-line-wavelength" plates.

The shape of the tuning curves in the series-condenser method of band-spreading differs considerably from the shape obtained with the tapped-coil method. In the former case the tuning curve tended to straighten out as the band-spread became greater (tuning range reduced) and the effective shunt capacity became smaller in comparison to the actual capacity in parallel with the whole coil. This is generally true with either this band-spread method or the simple system using a small parallel condenser (Fig. 712-A, *Handbook*) to which the tapped-coil method is essentially equivalent, unless the band-spread condenser has plates of unusual shape. The frequency of any tuned circuit is inversely proportional to the square root of the capacity, but if the *percentage* change in capacity is small, the tuning is very nearly linear with respect to capacity change. This can be seen by plotting a curve showing the variation of resonant frequency with tuning capacity. Any small segment not too near the low-capacity end is nearly a straight line even though the whole curve is far from straight.

With the series-condenser method the curves show a relatively rapid rise at low values of C_1, flattening off toward maximum capacity. The flattening of the curves becomes more marked as the series capacity at C_2 is made smaller. The reason for this is as follows: When C_1 is near minimum, its capacity is small compared to the capacity of C_2, consequently a small change in C_1 makes a relatively large change in the resultant capacity of the two in series,

and hence in the frequency of oscillation. However, when C_1 is near maximum capacity, particularly if C_2 is smaller than C_1, the change in resultant capacity is considerably smaller for a given change in C_1, consequently the frequency change is small. This characteristic of series band-spread circuits makes it necessary to use some care in choosing capacities for C_1 and C_2 if the band-spread tuning is to be reasonably uniform. If C_2 is smaller than C_1 the tuning will be relatively rapid at the high-frequency end of the band and quite slow at the low-frequency end. A better characteristic will be secured when C_2 is equal to or larger than the maximum capacity of C_1.

The condensers used in securing the curves of Figs. 6 and 7 showed practically no capacity variation in the first ten dial divisions starting from minimum capacity. This accounts for the fact that the curves begin at about 10 rather than at zero.

EXPERIMENT 37

Circuit Tracking

Apparatus: The circuit for this experiment is shown in Fig. 8. The plate power supply, tube board and circuit board are used. A small triode is connected as a Hartley oscillator, using a coil *L* from the circuit board. A 6J5 or similar small triode will be suitable. The grid leak is 50,000 ohms and the grid condenser 100 $\mu\mu$fd. The oscillator is shunt fed through the 2.5-mh. r.f. choke, *RFC*, with blocking and by-pass condensers of 0.002 μfd. each. The oscillator plate voltage can be obtained from the regulated tap on the power supply, using a VR-105-30 regulator tube. However, voltage regulation is not essential, and it will suffice to set the output voltage from this or another supply at about 100 volts, using the ordinary voltage divider.

The various condensers in the tuned circuit are: C_1, 25 to 50 $\mu\mu$fd. (small condenser on the circuit board); C_2 and C_3, 250 $\mu\mu$fd. each (condensers of higher or lower capacity may be used so long as the two are identical); C_4, 500 $\mu\mu$fd. fixed mica, subject to change according to circuit conditions.

A calibrated receiver is needed for measuring the oscillator frequency.

Procedure: The purpose of this experiment is to set up circuits which will track with a constant frequency difference, simulating the mixer (signal) and oscillator circuits in a superhet receiver. The oscillator is used as a convenience in checking the resonant frequency, which is measured by means of the calibrated receiver. The general coverage calibration of the average receiver will be sufficiently accurate.

To simulate the mixer or signal-frequency circuit the oscillator is first connected as shown at A in Fig. 8. C_2 is the tuning condenser and C_1 is a parallel padding condenser. Connect the two condensers and the tube across 30 turns of the coil, as shown in the diagram. Set the cathode tap 10 turns from the grid end of the coil.

Adjust the receiver to 4 megacycles, set C_2 at minimum capacity, and adjust C_1 to bring the oscillator frequency to zero beat with the receiver (the b.f.o. in the receiver should be on). Keep the receiver gain to the minimum necessary to give a good response. Move the tuning dial on C_2 ten divisions at a time, taking frequency readings by readjusting the receiver tuning to zero beat in each case, until maximum capacity is reached.

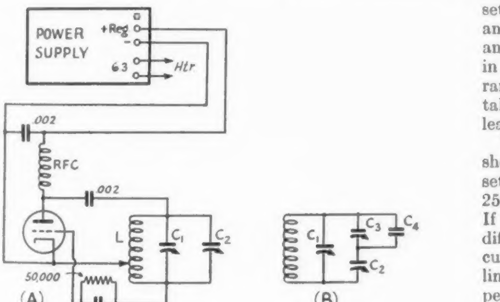


Fig. 8

Next, reduce the number of turns on the plate side of the coil by 5, so that the total number is 25. The connections from the stator plates of the two condensers, as well as the plate circuit lead from the tube, should all be moved down to the next tap. It will not be necessary to change the cathode tap. Set C_2 at minimum capacity, set the receiver to 4.5 megacycles, and adjust C_1 until the signal is heard at zero beat in the receiver. The difference between 4.5 and 4 megacycles, or 500 kilocycles, represents the intermediate frequency in this experiment. Now connect C_3 in series with C_2 as shown at B in Fig. 8 and connect the 500-$\mu\mu$fd. fixed condenser, C_4, across C_3.

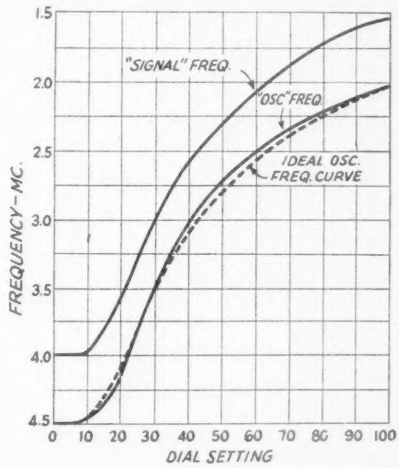


Fig. 9

Note the lowest frequency obtained on the first set of measurements, and add 500 kc. to it to find the low-frequency limit of the tuning range required in the circuit when it represents the superhet oscillator. For example, if the lowest frequency was 1500 kc., the lowest frequency to which the oscillator should tune will be 1500 + 500, or 2000 kc. The complete oscillator range therefore should be from 4.5 to 2 megacycles. Set the receiver to the required lowest frequency in the oscillator range (2 Mc. in the example), set C_2 at maximum capacity, and vary C_3 to bring the oscillator signal to zero beat with the receiver. If the signal is not heard, retune the receiver to find it. If the frequency is too high with both C_3 and C_2 at maximum capacity, more capacity is needed at C_4, while if the frequency is too low with C_3 at minimum and C_2 at maximum, the capacity of C_4 should be reduced. The proper capacity to bring the oscillator frequency to the right value at some setting of C_3 can be found by using small mica condensers in various combinations, if necessary. After the proper setting for C_3 has been found, set C_2 at minimum capacity, set the receiver to 4.5 Mc., and readjust C_1 to bring the signal to zero beat; then go back and check the low frequency again. Working back and forth in this way a few times will bring both ends of the tuning range to the proper frequencies. When this has been done, take frequency readings for every ten dial divisions of C_2, leaving the other condensers untouched.

When all the readings have been taken, plot the data as shown in Fig. 9, showing frequency as a function of dial settings. The condensers used in securing these curves were 250-$\mu\mu$fd. units having "straight-line-wavelength" plates. If the tracking is perfect, there will be a constant frequency difference of 500 kc. between the "signal" and "oscillator" curves. This ideal oscillator curve is shown by the dashed line in Fig. 9. Although the measured curve does not track perfectly, it follows the ideal curve fairly closely. Perfect tracking is not possible when identical condensers are used in the signal and oscillator circuits, but in practice quite good

results can be obtained. In the case shown in the curves, the maximum deviation from the ideal curve is about 75 kilocycles. The tracking is exact at the ends of the curve, since these points were set by measurement, and also is exact at a setting of about 27 on the dial, the oscillator frequency being slightly too high below this dial setting and too low above it. Such "crossing over" is characteristic of this tracking method.

Plot an ideal oscillator curve on the same sheet and compare the measured curve. Then take a new set of data by setting the oscillator frequency to give exact tracking at 20 and at 80 on the dial. This can be done by methods similar to those described above for aligning at the ends of the dial scale. In the curves of Fig. 9 the required oscillator frequencies would be 3575 + 500 kc. = 4075 kc. at 20, and 1725 + 500 = 2225 kc. at 80. Once the alignment has been secured, take frequency readings at every 10th division and compare them with the ideal curve. It will be found that the tracking is much more accurate over the majority of the tuning range than it was in the first case. In other words, the tracking adjustments should be made at frequencies somewhat removed from the extreme ends of the range in order to secure a better compromise over the whole range. Although there is not room to plot such a curve on Fig. 9, this procedure, applied to the set-up which gave the curves shown, resulted in reducing the maximum tracking error to less than 50 kc., while the average error over the whole range was considerably less.

The importance of proper tracking on the sensitivity of the receiver can be appreciated by referring to the selectivity curves taken in connection with Exp. 15 (Fig. 9, page 68, August *QST*). Although this curve happens to be for a frequency (3700 kc.) at which the tracking is good in Fig. 9, it is not difficult to see that if the tracking error of 75 kc. had occurred at this frequency the signal strength would be reduced in the ratio of 3 to 1, using the curve for no loading, and in the ratio of 2 to 1 for a load of 100,000 ohms. In other words, the higher the Q of the signal circuit the more serious is the effect of poor tracking.

EXPERIMENT 38

Discriminator Operation

Apparatus: This experiment requires the use of the power supply, oscillator, vacuum-tube voltmeter, test kit and the tube and circuit boards. The circuit arrangement is shown in Fig. 10. The coil L_1 is the movable coil from the circuit board, and replaces the plug-in plate coil normally used in the oscillator. The latter coil should be removed from its socket. The oscillator is operated self-controlled, using the grid coil instead of the crystal. About 30 turns should be used in L_1.

L_2 is the fixed coil on the circuit board, with 30 turns in use. The tap to which C_2 and the r.f. choke are connected is at the 15th turn. C_2 is the small condenser on the circuit board, maximum capacity 25 to 50 $\mu\mu$fd. C_1 is the tuning condenser associated with the fixed coil on the board; a maximum capacity of 100 $\mu\mu$fd. or more will be satisfactory. The rectifier tube is a 6H6 with 100,000-ohm load resistors by-passed by 100-$\mu\mu$fd. mica condensers. Larger by-pass capacities may be used if more convenient. The two r.f. chokes indicated in the diagram are 2.5-millihenry units. The loading resistor R is 50,000 ohms, 1 watt. Do not use a wire-wound resistor.

The v.t. voltmeter obtains its plate supply from the regulated tap on the power supply, using a VR-150-30 regulator tube. The oscillator plate supply is from the variable tap, which should be adjusted to give 15 or 20 volts under load.

A calibrated receiver is needed for measurement of oscillator frequency. The calibration of an ordinary communications receiver will be sufficiently accurate.

Procedure: To obtain reasonably good results in this experiment is necessary to use some care in setting up the circuit. The discriminator circuit should be perfectly symmetrical if the effects of stray currents are to be avoided. C_1 preferably should be a split-stator condenser on this account, but the ordinary type of condenser can be used if a balancing condenser, C_3, is installed. This condenser compensates for the somewhat smaller capacity to ground from the stator plates than from the rotor plates, if the condenser is of the usual type having a metal frame to which the rotor plates are connected. C_3 may be a small mica-insulated trimmer having a capacity range of 3 to 30 $\mu\mu$fd. Also, the tap on L_2 should be at the exact center of the coil. When using the coil on the circuit board the five unused turns at one end will have some effect on the symmetry; it would be better to wind a new coil having 30 turns only, but with care it will be possible to perform the experiment satisfactorily with the original coil. Another possible source of error is in capacity coupling between the adjacent ends of L_1 and L_2; this can be minimized by arranging the circuit so that the grounded end of L_1 faces L_2 when the coils are coupled.

The v.t. voltmeter is set on the low range. It is used only for measuring the rectified voltage developed across the load resistors. The rectified voltage could be determined by measuring the d.c. current through the 100,000-ohm resistors, but the current is too small to be read with sufficient accuracy by a 0-1 milliammeter. The r.f. choke in the "hot" lead of the v.t.v.m. is used to prevent r.f. current from flowing through the voltmeter circuit. It should be clipped to the end of the flexible lead from the voltmeter so it is as close as possible to the point of measurement. The rectified output of each diode is measured between the common (ground) connection between the two resistors and the points marked X_1 and X_2. The polarity of the measured voltage is always positive in this circuit arrangement.

As a preliminary check of the circuit symmetry, disconnect C_2 from L_2, couple L_1 and L_2 together, and set the oscillator frequency (by means of the variable condenser in the oscillator unit) to about 3 megacycles, as indicated by the receiver. Connect the v.t.v.m. to either X_1 or X_2, and tune C_1 for maximum v.t.v.m. reading. Adjust the coupling between the two coils to bring the v.t.v.m. reading to about half scale. C_3 should be set at about minimum capacity. Set C_1 as carefully as possible to resonance, indicated by maximum reading. Since the rotor of C_1 is not at ground potential, some hand-capacity effect will be observed; this can be compensated for by setting the condenser to a slightly higher capacity than exact resonance, so that the v.t.v.m. reading becomes maximum when the hand is removed. Note the v.t.v.m. reading and shift the "hot" lead to the other diode resistor. If the circuit is symmetrical the two readings will be the same. A difference of 10 per cent is permissible, but if the discrepancy is larger the probability is that the coil is not accurately center-tapped. In such case it is advisable to try a new coil, wound with greater accuracy.

When the two voltages are found to check satisfactorily, remove L_1 from the vicinity of L_2 so that the coupling between the two coils is negligible. Connect C_2 to L_2 and adjust its capacity so that a deflection of about half scale is obtained on the v.t.v.m., the v.t.v.m. being connected to either X_1 or X_2. Swing C_1 through resonance, observing the voltmeter indication; at resonance there will probably be a rapid change in the read-

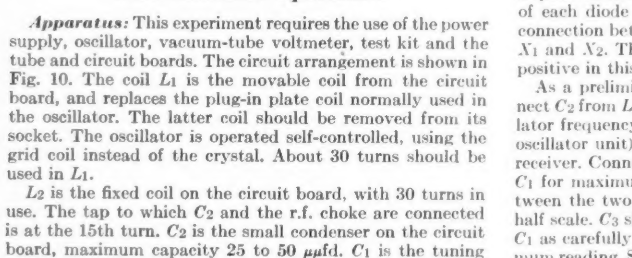


Fig. 10

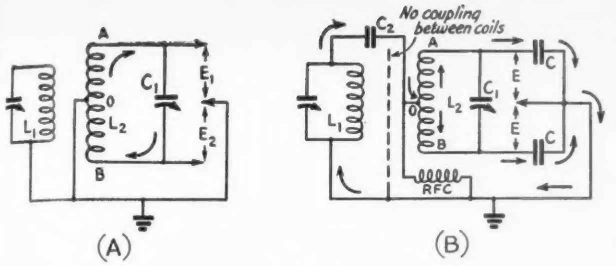


Fig. 11

ing. Adjust the capacity of C_3 to make this change as small as possible. The proper setting is likely to be near minimum capacity, and when the circuit is properly balanced the pointer of the indicating instrument should give only a small flicker, or none at all, as C_1 is tuned through resonance. Under these conditions the rectified voltages measured at X_1 and X_2 should be within a few per cent of being equal. However, such voltage measurements may not be valid if there is appreciable inductive coupling between the two coils. This point can be checked by observing, with C_2 disconnected, whether the v.t.v.m. shows any indication when C_1 is tuned through resonance.

The following explanation of discriminator action, more detailed than that given in the *Handbook*, should be of assistance in interpreting the results of the subsequent measurements:

When L_2 is coupled inductively to L_1 a current flows in the circuit formed by L_2C_1; it may have the instantaneous direction indicated by the arrows in Fig. 11-A. The voltage E_1 developed by the current in flowing through the reactance of the part OA of the coil is applied to one diode and that from the current flow through OB, E_2, is applied to the other diode. The instantaneous current is flowing toward the center-tap in OB and away from it in OA; that is, viewed from the centertap the currents are 180 degrees out of phase. Consequently the two voltages E_1 and E_2 also are out of phase with respect to the center-tap. These two voltages are equal, if the circuit is balanced, and result in equal rectified voltages from the two diodes. Because of the way in which the load resistors are connected, the points X_1 and X_2 are positive with respect to the common connection between the two resistors, so that the total voltage measured between X_1 and X_2 will be the *difference* between the two voltages. This difference will be zero, since the two voltages are equal.

When L_2 is not coupled inductively to L_1 but has its center-tap connected to the upper end of L_1 by means of C_2, the r.f. voltage across L_1 causes a current to flow as indicated by the arrows in Fig. 11-B. The circuit is completed through the capacity of the diode rectifiers and the by-pass condensers across the diode load resistors, the effective capacities being lumped together and represented by the condensers labeled C in Fig. 11-B. At the center tap of L_2 the current divides and flows through the two branches of the coil. Viewed from the center-tap these two components of the current are in phase. Since the diode capacity is only of the order of a few micromicrofarads, the reactance in this part of the circuit is quite high compared to the reactance encountered in either branch of L_2, with the result that nearly all of the voltage across L_1 appears between the diode plates and the return circuit (ground), without appreciable shift of phase. The r.f. choke provides a d.c. return circuit for the diodes but prevents short-circuiting the r.f. voltage in the return lead. The voltages between A and B are in phase with respect to the center-tap, hence there is no difference of potential between A and B. This is the reason why varying the capacity of C_1 should have no effect on the output voltage with the condenser coupling only; no current flows through the condenser because no voltage appears across its terminals. Since the same voltage is applied to both diodes, the rectified output voltages are the same from each, and again the total voltage between points X_1 and X_2 Fig. 10, is zero.

When the two methods of coupling are combined, the operation of the circuit is determined by the phase relationships existing between the voltages E, E_1 and E_2, Fig. 11. Both coils are in the same magnetic field, consequently the voltages *induced* in both are in phase. In the case of the primary, L_1, this induced voltage is the voltage appearing across the coil, since it is caused by the current flowing in L_1. The voltage induced in the secondary, L_2, is small, but causes a large current to flow in the series circuit formed by L_2 and C_1, when the circuit is resonant. At series resonance the induced voltage and current are in phase, since the inductive and capacitive reactances cancel, therefore the secondary current and the primary voltage are in phase. In flowing through the reactance of L_2 the current builds up a large resonant voltage (in proportion to the Q of the circuit) which appears across the terminals A and B, Fig. 11-A. In the coil this reactive voltage leads the current by 90 degrees, as in any inductance. These relationships are shown in Fig. 12-A, where E_p represents the primary voltage, E_s the voltage induced in the secondary, I_s the secondary current in phase with both the primary voltage and induced secondary voltage, and E_x the resonant voltage appearing across L_2, 90 degrees ahead of I_s in phase. (See Exps. 12 and 13.)

Viewed from the center-tap of L_2 the reactive voltage consists of two equal components 180 degrees out of phase, as explained above. This division of the voltage can be represented by two lines of equal length 180 degrees apart, as shown in Fig. 12-B, labeled E_1 and E_2 to correspond to the voltages indicated in Fig. 11-A. The primary voltage, indicated by E to correspond to Fig. 11-B, is now 90 degrees behind (in the counterclockwise direction) one part of the reactive voltage E_1 and 90 degrees ahead of the other part E_2. The resultant voltages appearing across each half of the coil, and consequently the voltages applied to each diode, are found by the triangular relationship. The resultant voltage can be found by drawing lines (shown dashed in the drawing) parallel to the voltage lines, beginning at the ends, to form a parallelogram. The diagonal of the parallelogram gives the amplitude of the combined voltage. At resonance, the two resultant voltages are equal, as shown by Fig. 12-B.

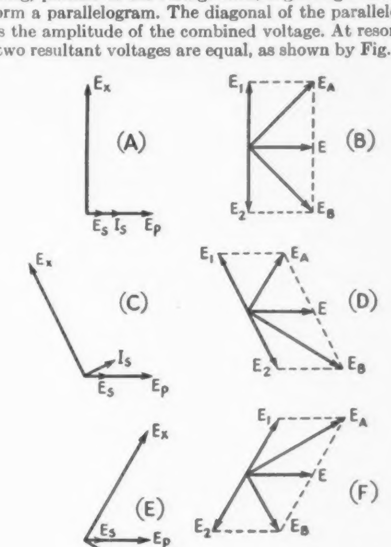


Fig. 12

The r.f. phase relationship between them is of no importance since it disappears in rectification. Since the amplitudes of the two voltages are the same, the rectified voltages are equal and the total output voltage (between X_1 and X_2, Fig. 10) is zero.

If the applied frequency is lowered, leaving the tuning of L_2C_1 unchanged, the voltage induced in L_2 is still in phase

with the voltage across L_1, since both voltages result from the current flowing in L_1. However, the series circuit formed by L_2C_1 is no longer resonant. Since the frequency has been lowered, the inductive reactance of L_2 is smaller than the capacity reactance of C_1, hence the net reactance of the circuit is capacitive. As a result, the current flowing in the circuit leads the induced voltage. This is shown at Fig. 12-C,

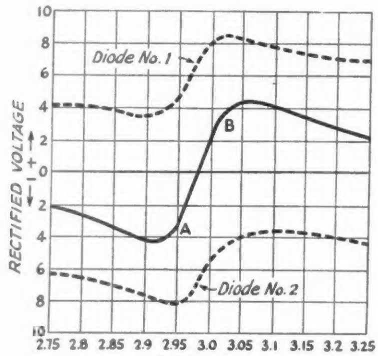


Fig. 13

where the designations correspond to those of Fig. 12-A. The reactive voltage, E_s, is 90 degrees in advance of the current, as before, and is therefore drawn at right angles to it as shown. From the viewpoint of the center-tap the conditions are as shown in Fig. 12-D, where the reactive voltage has again been split into two parts, E_1 and E_2, drawn at the same angle with respect to the primary voltage, E, as in Fig. 12-C. On completing the parallelograms to find the resultant voltages E_A and E_B, it is found that the amplitude of E_A has decreased and that of E_B increased, because of the shift in phase of the voltage developed in the resonant circuit. Consequently the voltage applied to one diode is greater than the voltage applied to the other. The rectified voltage appearing across the terminals X_1 and X_2 is the difference between the rectified output voltages of the two diodes. Since the diode on side A is assumed to have the smaller voltage (sum of E_1 and E, phase considered) it is less positive than the diode on side B. Hence A is negative with respect to B. If X_1 corresponds to A and X_2 to B, X_1 is negative with respect to X_2.

The conditions existing when the applied frequency is higher than the resonant frequency of L_2C_1 are shown in Fig. 12 at E and F. In this case the net reactance of the series circuit is inductive and the current lags behind the induced voltage. On dividing the reactive voltage into the two components it is found to combine with the primary voltage as shown in Fig. 12-F. In this case E_A is larger than E_B, so that the *other* diode now has the greater voltage applied. The rectified output voltages of the two diodes are in proportion, consequently a voltage appears between X_1 and X_2. However, the polarity of this voltage is opposite to that resulting from applying a frequency lower than the resonant frequency to the circuit, since the second diode is now at the higher potential.

The resultant voltage on either side, for a given frequency deviation, depends upon the amplitudes of the r.f. voltages acting in the circuit and on the circuit Q. The primary voltage, E, is independent of the Q of the secondary circuit since there is no resonant effect so far as it is concerned. In the case of an i.f. transformer, this voltage will depend upon the Q of the primary circuit in the same way that it does in any tuned circuit, so that the voltage will decrease on either side of the resonant frequency. (In the experimental set-up this variation is eliminated since the oscillator output voltage is practically constant over the frequency range used.) However, the current which flows in the secondary circuit as a result of the induced voltage will depend both in amplitude and phase on the Q of the secondary circuit. If the Q of the circuit is low, the change in amplitude is relatively slow and the phase change is likewise slow. If the circuit Q is high, both amplitude and phase change rapidly with frequency. For these reasons the frequency deviation at which the maximum resultant voltage (combination of reactive voltage and primary voltage) occurs will be larger as the Q of the circuit is made smaller. Conversely, if the Q of the secondary circuit is high the maximum resultant voltage will come at a relatively small frequency deviation from resonance. These facts can be made clear by assuming the induced voltage and reactance to be fixed, and then calculating the reactive voltage and phase change for various assumed values of internal resistance in the circuit (see Exps. 12 and 13).

To obtain the characteristic of the experimental discriminator, after having made the checks for circuit balance previously described, first move L_1 away from L_2 so that the inductive coupling is minimized, and then adjust C_2 so that the v.t.v.m. indication is at or slightly below half scale. Then disconnect C_2 from L_2, and couple the two coils so that the v.t.v.m. gives about the same indication as when coupling through C_2 alone. The voltage measurement may be made on either diode. Then restore the connection between C_2 and L_2, set the receiver to 3 megacycles, adjust the oscillator frequency to zero beat, and carefully tune C_1 to as nearly exact resonance as possible. The resonant point can best be checked by the effect of C_1 on the oscillator frequency. The reaction on the secondary circuit on the oscillator will be greatest at resonance, hence the oscillator frequency change will be most marked at this point.

Once the resonant point is found, do not touch the secondary tuning controls or the coupling between L_1 and L_2. Set the oscillator frequency to 2.75 Mc., as checked by the receiver calibration, and measure the rectified output voltage of both diodes. Then increase the frequency in steps of about 25 kc., taking voltage readings each time, until a frequency of 3.25 Mc. is reached. When the complete set of readings has been secured, convert the readings to volts by means of the v.t.v.m. calibration curve. The data may be plotted as shown in Fig. 13. Since the output voltage of the discriminator is taken between the points X_1 and X_2, Fig. 10, and the relative polarity of the voltage with respect to one end such as X_2 (which is grounded in the normal discriminator circuit) depends upon which diode is delivering the largest output voltage, the output of one diode can be plotted as "positive" voltage and the output of the other as "negative" voltage. That is, if X_2 is grounded the mid-connection between the two load resistors will be negative with respect to ground, because of the direction of rectified current flow, while point X_1 will be positive with respect to the mid-connection because the rectified current flows in the opposite direction through the upper load resistor. If the output voltage of the upper diode is larger than that of the lower, the net output voltage will be positive, and vice versa. Hence the output of the lower diode may be plotted as a negative voltage and the output of the upper as a positive voltage. The dashed curves in Fig. 13 show the results of such measurements. Below resonance the output of the upper diode (No. 1) decreases very slightly to a minimum at about 2.9 Mc., when it rises rather rapidly to reach a maximum at

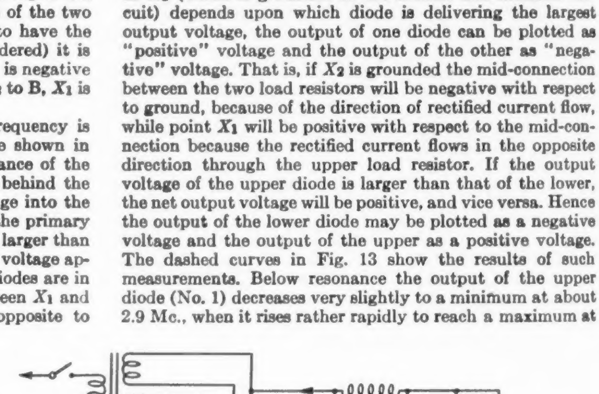


Fig. 14

about 3.025 Mc. As the frequency is further increased the output continues to decrease rather gradually. The curve for the second diode closely resembles the first except that the minimum occurs on the high-frequency side of resonance and the maximum on the low-frequency side. The region of rapid change is the region in which the phase shift is most rapid. With a lower circuit Q — obtained, for instance, by using a lower value of resistance at R — the change would be less abrupt, while with a larger loading resistance (or none at all) the rise in voltage in the vicinity of resonance would be more steep.

The discriminator output voltage is the difference between these two curves. To plot it, subtract the voltage from diode No. 2 from that of diode No. 1 at the same frequency, selecting as many points as are necessary to permit drawing a curve. If the output of No. 2 is larger than No. 1, the output voltage is negative, and vice versa. The solid curve shows the result of taking the difference between the two dashed curves in Fig. 13. The curve has a negative maximum at a little over 2.9 Mc. and a positive maximum at about 3.05 Mc. It crosses the zero line (equal voltage outputs from the two diodes) at 2.98 Mc., showing that this is the resonant frequency. The peaks are separated by about 150 kc. in this particular characteristic. The characteristic is straight between the points A and B, which would constitute suitable limits of frequency deviation for undistorted detection. Point A is at 2.95 Mc. and point B at 3.01 Mc., so that the maximum frequency swing which could be handled by this circuit would be 60 kilocycles. That is, the maximum permissible frequency deviation, corresponding to 100 per cent modulation of an amplitude-modulated transmitter, would be 30 kc.

For further investigation the same data may be taken with no loading on the secondary circuit, and also with 25,000 ohms at R. As the peaks come closer together it will be found that the adjustments are more critical, and measurements must be taken at smaller frequency intervals to obtain significant results. In all cases it is advisable to maintain the oscillator r.f. output voltage as constant as possible. Normally it should not vary more than a few per cent over the range 2.75 to 3.25 Mc., but if the variation is larger it may be compensated by adjusting the d.c. plate voltage on the oscillator. The r.f. voltage may be measured by connecting the v.t.v.m. across the primary circuit, using the medium voltmeter range.

EXPERIMENT 39

Voltage Regulation with Condenser- and Choke-Input Filters

Apparatus: The plate power supply and test instrument are used for this experiment. An adjustable load resistor, R, Fig. 14-A, also is required. It is convenient to use two resistors in series for this purpose, one a 25,000-ohm 25-watt unit and the other 25,000 ohms with a 50-watt rating. Both should be adjustable by frequent taps or sliders. Disconnect the regular bleeder resistance in the power supply and substitute the load resistor as shown. The test instrument may be used to read both current and voltage if provision is made to complete the circuit to the resistor when voltage readings are being taken. A push-button can be used for this purpose.

For the choke-input filter test, the first filter condenser in the power supply should be temporarily disconnected, giving the circuit shown in Fig. 14-B.

Procedure: The purpose of this experiment is to compare the effect of choke- and condenser-input filters on output voltage as the load current is varied. Taking first the condenser-input filter, measure the voltage with no load except the voltmeter on the power supply. Then connect the load resistor and increase the current in steps of approximately 10 milliamperes until a maximum current of 100 ma. is reached, noting the output voltage at each current. Use the heavier load resistor for the higher currents. Then disconnect the first filter condenser so that the circuit becomes that of Fig. 14-B and repeat the procedure. Plot the data to show output voltage as a function of load current.

The curves of Fig. 15 show the results of such a procedure using the power supply described in Installment 3. The transformer in the supply is rated at 350 volts each side of the centertap. With no load on the supply the output voltage is approximately the peak value of a 350-volt sine wave, or $350 \times 1.41 = 490$ volts. This is true with either the condenser- or choke-input filter. As the load current increases, the output voltage drops off with the condenser-input filter as shown by the upper curve in Fig. 15. With the choke-input filter the decrease is most rapid at low load currents,

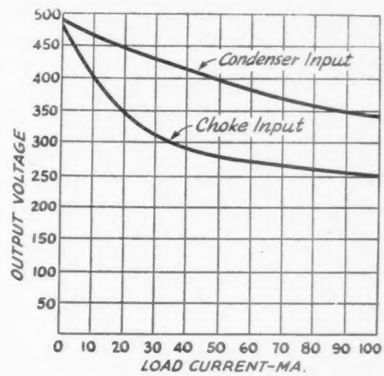


Fig. 15

then levels off at a current of 30 to 40 milliamperes. In this region the output voltage is equal to the *average* value of the a.c. transformer output (peak $\times$ .636 or 310 volts) and further decreases in voltage result from IR drop in the filter choke and rectifier tube, as well as voltage drop in the transformer itself. This is the characteristic operation of the choke-input filter, and results from the tendency of the input choke to smooth out the variations in the output current of the rectifier, permitting only the direct current (which is the average of the rectified wave) to flow. With the condenser-input filter, on the other hand, the input condenser charges with each pulse of rectified current from the rectifier, and discharges only as much (when the rectifier output is in the low-voltage part of the cycle) as is permitted by the time constant of the circuit. Consequently the output voltage will be high when the load current is low, and will decrease when the load current is high, since a high load current represents a low load resistance and hence a smaller time constant, the capacity in the circuit being fixed. Increasing the input capacity will increase the time constant and thus increase the output voltage for a given load current, and vice versa.

The point at which the output voltage of a choke-input rectifier reaches the average value of the rectified a.c. is determined by the relationship between load resistance and choke inductance, as explained in the *Handbook*. With a given load resistance, the initial drop in voltage comes at a smaller load current as the input inductance is increased. In Fig. 15 the "critical" point is with a load current of about 30 ma. The load resistance at this point is equal to E/I, or 310/0.030, which is approximately 10,000 ohms. Using the formula for critical inductance, $L = R/1000$, indicates that the effective inductance is about 10 henrys at this current. The voltage regulation beyond this point is not particularly good in Fig. 15 because of the voltage drops in the choke and rectifier. With mercury-vapor rectifiers and low-resistance chokes the regulation can be held within 10 per cent in a reasonably well-designed power supply.

ANSWERS TO QUESTIONS IN INSTALLMENT 6

If no answer is given, it is to be found in the appropriate *Handbook* section or in the description of the experiment or experiments accompanying that Assignment.

(*Continued on page 110*)

STRAYS

A pocket-size booklet, *Thirteen Ways to Prolong Tube Life,* may be obtained upon request from Heintz and Kaufman, Ltd., 1015 Tanforan Ave., South San Francisco, Calif. Supplying several helpful hints on getting the longest service from electronic tubes, it considers plate dissipation, proper tuning of circuits, reduction of "no-signal" plate current in Class-B audio amplifiers, minimizing stray circuit losses in Class-C stages, adjusting grid drive, maintaining rated filament voltages, preventing parasitic oscillations and other subjects.

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W1EEY suggests that four-prong cable plugs and sockets on emergency gear with the standardized connections recommended in *QST* for December, 1941, be furnished with some sort of identification, such as a red dot, to distinguish them from other cable connectors.

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W4EFX (RM1c) sends this one after his first trip over rough seas:

Sail, gale, pale, rail. — *The (N.C.) Arc.*

A new process for separating valuable metals from low-grade ores has recently been laboratory-tested. In this process, the ore is "sprayed" by an electrical charge. The separator then "washes" out the desired metal by a principle similar to the attraction of iron filings to a magnet. In tests, 95 per cent of the tin present was removed from low-grade ore. — *Ohmite News.*

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Engineers of the General Electric Co. are now working on the construction of a 100,000,000-volt X-ray machine. To prevent penetration, the walls of the building are three feet in thickness!

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The Cleveland Indians baseball team now uses a complicated electronic gadget set up in a trailer for testing the speed of the "smoke" balls of prospective pitchers!

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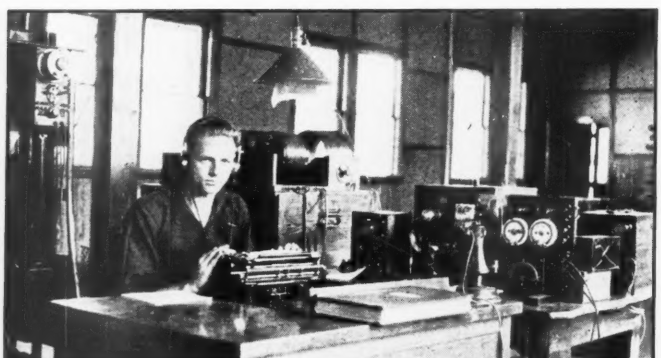
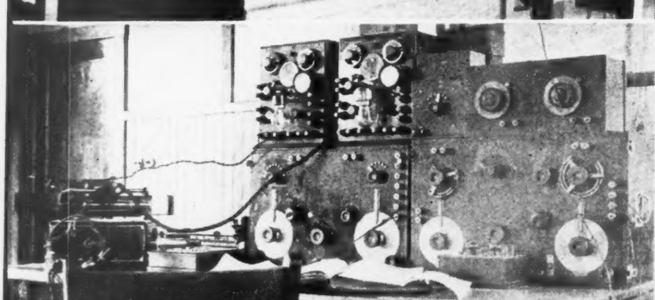
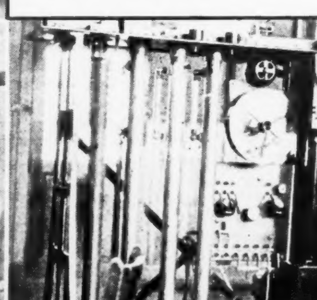
The Materials Laboratory of the Army Air Forces uses an electronic instrument which can distinguish between any two of over two million shades of color!



Hams using modern U. S. Navy equipment will gaze with thoughtful (if nostalgic) eyes at these photos of old NBD, Mt. Desert Isle, Maine, from P. E. Nelson, W5GNF. *Upper left* — Operating position, with Alexanderson barrage receiver in central background, audio amplifiers at right. *Lower left* — Various items of Navy equipment standard twenty years ago — SE899 receivers, wave-meters and audio amplifiers. Note the Ediphone recorder at left. *Below* — Early high-speed chemical tape recorder. Drum at right contains unexposed tape film, with solutions for developing and drying tape in vertical tubes.





ON THE ULTRAHIGHS

CONDUCTED BY E. P. TILTON,* W1HDQ

THERE have been many guesses as to the number of amateurs who made the ultrahighs their stamping ground in recent years. We have been asked many times for figures on this and have heretofore gone only as far as the guessing stage ourselves, because of the time-consuming nature of the task involved in compiling any actual figures. The records of the UHF Marathon contain the figures, at least as far as 56-Mc. operation is concerned. There is little doubt that no station reared its head above the 56-Mc. horizon in 1941 without being promptly jumped on by at least a few of our enterprising contestants. As to 112 Mc., we have to use round numbers, at least for all but the most heavily-populated areas, but the figures given below may be considered a fairly close approximation of our actual 112-Mc. population in 1941.

Marathon reports show that at least 822 stations engaged in two-way work on 56 Mc. during the year, with this activity well distributed over the country. Only six states — South Carolina, Tennessee, Mississippi, Colorado, Utah and Nevada — are missing. Distribution of activity was as follows:

W1	193
W9	139
W8	124
W2	118
W3	112
W6	59
W5	37
W4	22
W7	18
Total	822

Perusal of the calls listed, especially those most frequently mentioned, shows that a large percentage of five-meter enthusiasts were men of long-standing amateur experience. Many of them are veterans of eight, nine, and even ten years of continuous plugging on Five, not a few of these having never operated on any other band! 112 Mc., on the other hand, shows its tremendous appeal for the amateur newcomer, with nearly 400 M and N calls included in the W1 and W2 roster alone. Significant in the reports of both bands is the frequent listing of well-known two-letter calls and others dating back to the earliest days of amateur radio — proof of the pleasure that many old-timers found in the friendly contacts that were available on the ultrahighs, as well as the satisfaction to be found in pioneering in a new field.

During late 1940 and in 1941 activity on 112 Mc. grew at a terrific pace, until almost every city of any size could boast of its local group of 2½-meter stations. This was most fortunate, for now these fellows who have had a chance to learn their way around on 112 Mc. are serving their communities well in the organization of WERS activity. Many of these men are now in the armed services, and others have been transplanted far from their home territory in civilian work connected with the war effort, but a call for help in almost any community still turns up at least a few fellows who have had u.h.f. experience.

Because of the essentially local character of 112-Mc. work, much of it went unreported; hence our figures for this band cannot be exact. But it is safe to say that W1 and W2 could claim about 600 stations each, with W9, W6, W8, and W3 following, in that order, with 350 to 500 each. W7, W4, and W5, with 50 to 100 each, bring the country's total up to well over 3000 stations active on 2½; a fair slice of the really active amateurs of the nation. These men, and the gear they built and used, assume an ever-increasing importance as WERS organization gets rolling and the shortage of gear for 112-Mc. use becomes increasingly acute. There should be a determined effort in every community to keep this gear from being stowed away to gather dust in attic or cellar for the duration!

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Letters continue to come in from members of the u.h.f. fraternity who have been uprooted by the war effort. Those who are still in places where *QST* can get to them report that they look forward to it each month as the only means of keeping in touch with their amateur associates of better days, and some who are in far-away lands write that they would welcome a line or two from the old gang. This department will continue to serve as a clearing house for changes of address among the u.h.f. gang.

Fort Monmouth, this month, added at least two five-meter men to its roster, W1MEP and W4FKN both arriving at Camp Edison for four weeks basic training prior to transfer to Signal Corps School at Fort Monmouth proper. Chet reports that upon completion of this basic training the transfer is made on foot, a distance of 18 miles. After years of foot work on Vermont's Long Trail, Chet looks forward to this workout as a day's vacation! He would like to meet some of the other fellows stationed at Monmouth or to hear from any of the u.h.f. gang. He may be ad-

(*Continued on page 86*)

HINTS AND KINKS FOR THE EXPERIMENTER

BOOSTING TRANSCEIVER PERFORMANCE

In May of 1940, I built the battery transceiver for 112 Mc. described on page 28 of *QST* for April of that year. This unit was built because of the desire to have a self-contained unit, battery operated, which could be operated at any point with no external power pack. While the unit turned out to be very good as a receiver, I was never quite satisfied with its performance in transmitting. Power output was not as great as I wished and the frequency drifted badly when shifting between receiving and transmitting.

In connection with this, W1LIH made some suggestions which I followed with very good results. I took out the mica trimming condenser (C_2 in the original diagram) used as a band-setting condenser, and returned to the simple coil and condenser tuning system, since the mica condenser seemed to be responsible for most of the frequency drift. I also moved the antenna and d.c. connections from the center of the plate coil to one end as shown in Fig. 1. The regeneration control and dropping resistor (R_4 and R_5) were interchanged to permit lower plate voltage on the HY615 when receiving. The 6G6G was replaced with a 6V6GT for greater audio output, since the former did not seem to provide full modulation. The cathode resistor, R_3, was replaced with a 500-ohm, 10-watt variable unit, to eliminate the necessity for a microphone battery. I also put in a shielded 4-wire power cable so that the unit could be operated from a vibrator or a.c. pack whenever either was available. A 5-inch p.m. speaker was added with a switch to cut it out.

I found it necessary to twist the filament wiring together to avoid hum when using a.c. supply. One side of the filament should be grounded at each socket. The results were far beyond anything I expected. Reports of S8 to S9 were received at distances up to 30 miles and we had two contacts at 45 miles with the rig on the operating desk and a 45-inch rod for an antenna! For mobile operation we used a three-quarter-wave antenna with concentric feed. The rig was also used in portable operation a couple times with good results on the 45-inch rod, so the location was not the answer.

The matter of frequency drift was carefully checked in a number of QSOs and no drift was found. A number of stations reported us to be the loudest transceiver they had heard and the audio quality excellent. — *L. R. Mitchell, W1HIL*

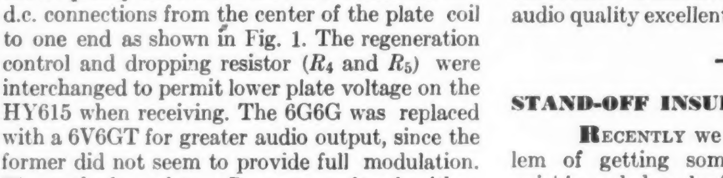

Fig. 1 — W1HIL's revamp of the transceiver circuit shown in April *QST*.

- C_1 — 30-μμfd. mica trimmer.
- C_3 — 3-plate midget variable (Hammarlund HF15, 2 plates removed).
- C_4 — 100-μμfd. mica.
- C_5, C_6 — 0.01-μfd., 600-volt.
- C_7 — 0.002-μfd. mica.
- C_8 — 20-μfd., 25-volt elect.
- C_9 — 0.25-μfd., 400-volt.
- R_1 — 15,000 ohms, ½-watt.
- R_2 — 125,000 ohms, ½-watt.
- R_3 — 500 ohms, 10-watt variable.
- R_4 — 0.1 megohm, variable.
- R_5 — 0.1 megohm, ½-watt.
- L_1 — 2½ turns No. 14 enameled, ⅝ inch dia., ⅝ inch long.
- L_2 — 7-hy., 40 ma. choke.
- RFC — Ohmite Z-1 r.f. choke.
- T_1 — Transceiver transformer (Thordarson T72A59).
- S_1 — 4-circuit single-gang selector switch (Mallory 3243J).
- S_2 — S.p.s.t. toggle.

STAND-OFF INSULATOR KINKS

Recently we were faced with the problem of getting some feed-through insulators quickly and cheaply. Since we had none on hand,

but had several ordinary 2¼-inch stand-off insulators, we rigged up a very satisfactory substitute by boring a ¾-inch hole through the chassis and bolted the stand-off in place as shown in Fig. 2A. Not only are the electrical and mechanical characteristics of this arrangement satisfactory, but the appearance is good also.

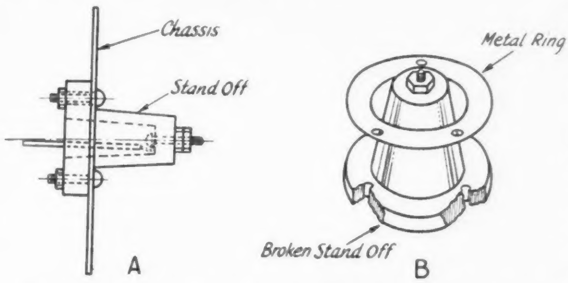

Fig. 2 — **(A) Stand-off insulator as feed-through. (B) Repair for circular-base stand-offs.**

This brings up another idea in relation to stand-offs which might prove useful. A good many hams have some of the old circular-base insulators with three-hole mountings in the junk box. Since the base is very fragile, they usually have one or more of the mounting holes chipped away. We have found that we can use stand-offs of this type which have two or even three mounting holes gone, by cutting a metal ring of the same diameter as the base and placing the ring over the stand-off before bolting it to its mounting. — *Dale Scarbrough, W6UCM and Laverne Hixson, W6TZY*

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THE VERSATILE REGENERATIVE-DETECTOR RECEIVER

Last fall I built a small regenerative receiver using a 1S4 miniature tube with 9 volts on the plate and screen. Here are some of the uses I have found for it:

First, it can be used as a regenerative r.f. stage on a superhet. Both receivers are connected to the same antenna and ground leads and are tuned to the same frequency.[1] Adjusting the regeneration control will cause the gain of the superhet to increase amazingly. Stations that were inaudible before the regenerator was used come up to comfortable volume. The better the regenerator is tuned and the nearer oscillation it is set, the greater will be the gain. Signal-to-noise and signal-to-image ratios are also improved.

Second, it may be used for code instruction. Recently I was asked to give a code demonstration before a group of about 30 people. The a.f. oscillator I had was a small battery rig for headphone use only. Not desiring to build a larger rig, I let the regenerator oscillate and plate-modulated it through a 3-to-1 transformer, the code oscillator furnishing the audio signal. I tuned this in on a b.c. receiver and had volume to spare.

Third, it may be used as an induction transmitter. With the set oscillating and a magnetic speaker hooked in the positive "B" lead as a microphone, the signal may be picked up on the b.c. set for the amusement of friends.

Fourth, by checking the frequency against one receiver of known calibration, it may be used to align other receivers.

Last, it is an excellent receiver for portable use, giving good headphone strength on most signals.

The size of the gadget is 4 x 4½ x 2¾ inches. Two standard flashlight cells are used for the 1½-volt "A" battery, while six "pen-lite" cells are used to obtain 9 volts of B supply. I have wound coils to cover all frequencies between and including the 19-meter and standard broadcast bands. All in all, it is a cheap, useful and interesting device to have around. In fact, I often wonder how I got along without it. — *Robert Price, Laurel, Miss.*

[1] Another method is simply to connect a coil of a turn or two in series with the antenna lead to the superhet, this coil being loosely coupled to the grid coil of the regenerative detector. — W1IW in "For the Experimenter," *QST*, December, 1935.

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CABLE CONNECTORS FROM OLD METAL TUBES

What with priorities, shortages and materials being generally unobtainable, I found one remedy for the trouble of getting an occasional connecting plug for equipment. As shown in the drawings of Fig. 3, use is made of old metal tubes salvaged from the junk pile. These are taken apart and all of the elements removed, leaving the bakelite base and the metal jacket. Holes may be drilled in the end or side of the jacket and a rubber grommet inserted to provide an opening for the cable. After the wires are soldered in the pins, the jacket is slipped up and clamped on the base. The jacket may be grounded for better shielding if desired. I have found this a good substitute for regular parts which often cannot be obtained and hope that someone else will benefit from this "brainstorm." — *G. Pennington Schleicher, W9NLT*

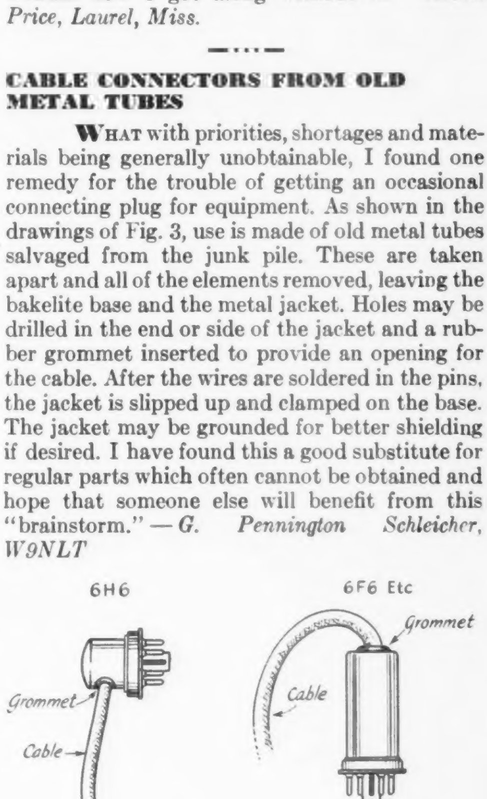


Fig. 3 — **Homemade cable connectors from old metal-tube envelopes.**

CORRESPONDENCE FROM MEMBERS

The Publishers of *QST* assume no responsibility for statements made herein by correspondents.

SUGGESTIONS

Brewster, Mass.

Editor, *QST:*

I have been intending to write you for some time as there are a number of things which I wanted to say. . . .

In the first place, you will notice that a check is included in this letter for the sum of $15. It is intended that this be used to keep up my membership in the League during the time that I am in the Navy. You see, I am a member of the Naval Reserve in the V-7 class and I have just been notified that I am to report for schooling. As I have no way of knowing how soon I will again find it convenient or possible to write you and send along my membership dues, I have decided to lump them all together for the next five years — that explains the size of the check. The issues of *QST*, which I sincerely hope will be coming along continuously, may be sent to the above home address, and I'll look forward to picking them up when this mess is over.

In the second place, I want to express my gratitude to you at Headquarters for keeping up the magazine, and not only keeping it up, but making it perhaps more interesting than it was before. You certainly deserve a lot of credit for its present size and excellence and I just want to chime in with the host of others who have been expressing the same feelings. It is most comforting to a ham who earnestly hopes to have the bands returned to us after the war to see that the men who represent us are capable and responsible, as you are making it plain that you are. My heartiest congratulations to you and to the fraternity of amateurs who saw to it that you were chosen for your jobs.

I have a few suggestions of a rather prosaic nature which I'd like to pass along to you. The first one is in connection with the advertisement of the League which appears perennially in the *Handbook.* I have hoped to see it changed through the several years that I have been buying the book and to date these hopes have proved fruitless. In my opinion there is entirely too much stress placed upon the availability of *QST*s if one becomes a member of the League, and I think that the emphasis is placed mistakenly. I feel that the most important thing for us all to remember about the League is what it has done for the amateur in the past years, what it is doing for us now and what it will be able to do for each and every one of us in the future if we will only get behind it and give it the support which it so richly deserves. It seems to me that the fact that *QST* comes a few cents cheaper through League membership is interesting but insignificant when compared to the importance of the bond which the League forms between us and the service which it renders us. It is an organization which deserves to have every amateur in the country behind it, and if you could call the fact to the reader's attention a little better I think it would be an improvement. (See the 1943 *Handbook,* p. 479. — ED.)

Is there no chance, by virtue of the undeniably special nature of W1AW, for us to have the home station on the air again nightly for the code proficiency runs? It seems a great mistake to take from those who want to improve themselves in the specialized field of code reception the best means at their disposal. I have learned touch-typing this summer in my spare time because, while I can receive the code at a speed of about 45 w.p.m. in my head, I can write no faster than 25. But now that I have the typing up to speed I find it hard to get code sent at a speed that will break me in gradually to the business of punching keys to the sound of code letters. I wish that the Hq station were on the air; it might help very much in making me a much more valuable man to the Navy when I do go. I should think that a kindergarten student in the art of persuasion could convince the authorities that W1AW would transmit no information of military importance and that its services to the amateurs and to all the host of people who are now trying feverishly to learn the code would, by the same token, be a real and lasting service to the nation which is at the present time keeping the station quiet. If there is anything which an ordinary ham could do to help put the station back on the air, please let me know and I'll be glad to help if I can. . . .

I guess that's about all, except to wish you all the best of luck for the duration and until we're all back on the air again. We've got a great hobby in radio. I only wish that it would be possible to convince all amateurs that they owe a duty, not to themselves alone, but to every person in the country who enjoys our hobby, to join in the organization without which neither they, nor any of us, would be able to say proudly: "I am a radio amateur."

— *J. David Cist, W1NDK*

CONSEQUENCE

568 W. Clapier, Philadelphia, Pa.

Editor, *QST:*

In the June, 1939, issue of *QST* we were fortunate enough to have published an article, the title of which was "A *QST*-Size Super." I suppose we received the usual mail that inevitably follows the publication of such an article. I do remember receiving a postal card at the time from a chap 100 miles from here, inquiring about a possible trade for the receiver in exchange for a Model A Ford sedan. We made a number of lasting friends as a result of the article. It had slipped my mind recently, and my work with the Signal Corps . . . pushed it farther from mind.

Imagine my surprise the other day when, upon answering the telephone, I was greeted by an inquiring voice which stated that the city detective bureau wished to speak to me. As I had entertained two gentlemen from the FBI a few days before, my reaction was, "What next?" (Suffice it to say the FBI visit was a routine investigation of the different amateur operators in this vicinity with regards to some unlicensed station, and had nothing to do with me personally.) At any rate, the party on the other end of the telephone wire said that the city detective bureau had picked up a boy in one of the city parks. In the boy's bag was found a model of the set I had described in *QST*. He had the magazine with him to prove his point. They told me over the 'phone that they had cleared him, and would like me to tell them how he could get out to my home in the suburbs. I, of course, was very curious about the whole affair and promptly gave them the instructions.

Two hours later the boy in question was at our front door. His story was both amusing and pathetic. It seems he had constructed the set — and I may add it was a fine example of construction — but had not had the opportunity to try it, as he lived in a part of New York City which is supplied with d.c. mains. He was scheduled to be inducted into the Army shortly, and during the remaining few days prior to his induction he had decided to run down to Philly. . . . He boarded the bus in New York and got off at a stop north of Philly. He was dressed rather oddly and spoke broken English. Apparently some eagle-eyed policeman spotted him and began to query him. As previously mentioned, his English was very difficult to understand, and they of course thought it was odd that he had the receiver in his overnight bag. They whisked him off to City Hall, and both the local detective bureau and FBI cross-examined him. He was picked up at 2 P.M. in the afternoon and not released until that time the next day. He had not brought any night clothes with him so he slept on a bench in one of the cells at City Hall in his street clothes. I must say he was a sight when he finally arrived at our house. . . .

To make a long story short, we got the set working (the i. f. was out of alignment) and gave him some helpful hints. He departed at 8 P.M. on a bus back to New York.

So you can see how a small article in *QST* brings the author a lot of surprises along with honor of finally making the pages of good old *QST*.

— Bill Alexander, W3GFZ

FROM A MARINE ON GUADALCANAL

Guadalcanal, Solomon Islands

Editor, *QST:*

. . . Thought I would write a few lines so that some of my radio pals — OMS, YLS, etc. — will know that I am OK and still in the radio racket. Lately I have been copying press news, on this, the only available typewriter, for my outfit here every evening. Have been copying KFS in San Francisco, which comes in here on the Island about S5 R5 with very little interference except for local communications.

I have not yet received a copy of *QST* since I arrived here on the Island, but I can understand that because even first class mail is slow in reaching this point. . . . I hope to see my back copies catch up with me in the future. Sure hope my folks have renewed my membership. . . .

I have run into quite a few amateurs here, including W8RTK, W3TLP and a W3 from Montgomery, Ala. . . .

Well, to all my radio friends in the service and civilian life that may read this, I wish them all the luck in the world, and hope to be back to hook up with them on the old 40-meter band again. . . .

— Pfc. Zane E. Sprague, W9UZW

PLACEMENTS

129 Clinton St., South Bound Brook, N. J.

Editor, *QST:*

Through your assistance in registering radio personnel, I have secured a position as field engineer on naval radio equipment. . . .

Many thanks for your coöperation, and 73.

— Alfred J. Bremmer, W3AXC

P. O. Box 34, Petrolia, Pa.

Editor, *QST:*

Some time ago I sent in a personnel availability blank from *QST*. Since that time I have . . . secured a position. . . .

The prospects appear very good and I appreciate the part you had in getting me located there. . . . *— Gerald L. Coulter, W8TSY*

(*Continued on page 78*)

OPERATING NEWS

GEORGE HART, W1NJM, Acting Communications Manager

OCD Announcement. The Office of Civilian Defense in Washington announces, after a conference with FCC officials, that in the future it will not look with disfavor on any WERS application from an individual town or other municipality. Previously, individual-city applications not providing for eventual consolidation on the recommended warning-district basis were disapproved by OCD upon inquiry to them from FCC. To speed up licensing procedure, however, so that every community possible may have an emergency defense communications system, the new policy has been adopted.

It will remain the objective of OCD eventually to consolidate the various units in any one warning district under a suitable form of organization and coöperative control, whether or not there exist separate licenses. The OCD communications booklet on WERS, expected later this year, will base its organization along such lines.

This announcement has no particular effect on the progress of amateurs as WERS sponsors, of course. While thoroughly recommending the warning-district plan, *QST* has always added that plans should go forward on an individual basis if indeed it were more feasible. Those who have already set up district organization and those now organizing who will insist on retaining it are secure in the knowledge not only that they have already complied with what OCD will shortly be asking of all groups, but also that they probably have a more efficient and secure operating system.

This change of policy is the go-ahead signal to those many municipalities who have been delaying their organization to wait for the more backward parts of their warning areas. It also opens a wider field of ideas and endeavor on the part of individual municipalities. Elsewhere in this issue we present the story of the organization of WERS in the city of Akron, Ohio. This is presented not so much as an example of the typical setup as it is to show that FCC/OCD will give approval to systems in variance with those originally contemplated provided they are practicable and operated in accordance with the WERS Rules and Regulations.

It is still necessary that independent-municipality licensees have radio communication liaison with their district control centers. In the event that the Interceptor Command orders the close-down of all WERS, only the warning area center receives the order. It is then up to them to see that all parts of the warning area receive this order. If telephone communication wires are down at the time, as they might well be, radio communication will be the only means of transmitting these orders. Furthermore, experience has shown that bombardment effects are always concentrated, resulting in severe damage to some parts of the warning area while others remain unscathed. Therefore OCD is arranging for what might be called warning-area strategy councils, representative of the whole area, which will be able to direct unhit towns to the assistance of hit ones.

When OCD required organization on the warning-area basis, this was automatically cared for. Now it becomes a matter of intercity coöperation on a voluntary basis. The best way to accomplish this is to have the independent cities recognize the radio aide of the d.w.c. city as having the superior authority, and to permit him to specify what intercity links must be set up.

Club Training Programs. It has been gratifying to note that hundreds of war training classes throughout the country have continued successfully despite incredible handicaps. WERS training and code/theory training should not be allowed to interfere with each other, but should go hand in hand. In this way many students interested only in WERS may be converted to code and theory, and vice versa. We still have a plentiful supply of code and theory outlines available to instructors upon request. Reprints of the article of October *QST* on WERS operator-training are also still available.

Honor Roll. All clubs conducting code and/or theory programs are still eligible for listing in the Honor Roll, but we cannot list your club if we receive no report. Clubs, make it a policy to drop us a note every month giving the latest dope on your training program. This information will not only make some groups eligible for Honor Roll listing, but will add to our card file of information on the subject, which information is available to persons inquiring where they may receive radio code or theory training.

More Changes. No *new* faces in the Communications Department yet, just *fewer* faces. After a brief but brilliant career as Acting Communications Manager, John Huntoon, W1LVQ, has left for active duty with the U. S. Coast Guard Reserve. Their gain is very much our loss. We all hated to see John go, and wish him the very best of luck in his new work. The rest of your operating staff will find it tough sledding without him.
— *G. H.*

Honor Roll

The American Radio Relay League War Training Program

Listing in this column depends on an initial report of the scope of training plans plus submission of reports each mid-month stating progress of the group and the continuance of code and/or theory classes. All Radio Clubs engaged in a program of war radio training are eligible for the Honor Roll. Those groups listed with an asterisk teach both code and theory. Others conduct only code classes.

***Albany (N. Y.) Amateur Radio Assn.**
Amateur Radio Transmitting Society, Louisville, Ky.
Central New York Radio Club, Syracuse, N. Y.
***Central Oregon Radio Klub, Bend, Ore.**
***CQ Radio Club, Torrington, Conn.**
***Detroit (Mich.) Amateur Radio Assn.**
***East High School Radio Club, Youngstown, Ohio**
***East Texas State Teacher's College Amateur Radio Club, Commerce, Texas**
***Edison Radio Amateur's Assn., Detroit, Mich.**
***Federation of Long Island Radio Clubs, Jamaica, N. Y.**
Heart of America Radio Club, Kansas City, Mo.
Mountaineer Amateur Radio Assn., Clarksburg, W. Va.
***Nassau County War Council, Mineola, L. I., N. Y.**
New Haven (Conn.) Amateur Radio Assn.
Richmond (Ind.) Amateur Radio Assn.
***St. Paul (Minn.) Radio Club**
***Southtown Amateur Radio Assn., Chicago, Ill.**
Sunrise Radio Club, Hollis, N. Y.
Tucson (Ariz.) Short Wave Assn.
***West Phila. (Pa.) Radio Assn.**

D.V.R.A. ANNUAL OUTING AND HAMFEST

A bit late, W3GCU reports the Annual Outing and Hamfest of the Delaware Valley Radio Association, held at the New Jersey State Fair Grounds, Trenton, in August, 1941. Standing, left to right, W3JCG, Joseph P. Meehan; kneeling, W. H. Atkinson and W3JMP. The generator in the background is a Blue Diamond gas-driven with output of 110 v. a.c. at 300 watts and 7.5 v. d.c. at 200 watts. The rig shown is a 2½-meter transmitter with 12.5 watts input on 114.2 Mc.

ELECTION NOTICES

To all ARRL Members residing in the Sections listed below:

The list gives the Sections, closing date for receipt of nominating petitions for Section Manager, the name of the present incumbent and the date of expiration of his term of office. This notice supersedes previous notices.

In cases where no valid nominating petitions have been received from ARRL members residing in the different Sections in response to our previous notices, the closing dates for receipt of nominating petitions are set ahead to the dates given herewith. In the absence of nominating petitions from Members of a Section, the incumbent continues to hold his official position and carry on the work of the Section subject, of course, to the filing of proper nominating petitions and the holding of an election by ballot or as may be necessary. Petitions must be in West Hartford on or before noon of the dates specified.

Due to resignations in the Missouri and Eastern Florida Sections, nominating petitions are hereby solicited for the office of Section Communications Manager in these Sections, and the closing date for receipt of nominations at ARRL Headquarters is herewith specified as noon, Tuesday, December 15, 1942.

Section	*Closing Date*	*Present SCM*	*Present Term of Office Ends*
Georgia	Nov. 16, 1942	William U. Hanks	Nov. 29, 1942
Alaska	Dec. 1, 1942	James G. Sherry	June 14, 1942
Southern Minn.	Dec. 1, 1942	Millard L. Bender	Aug. 22, 1942
Western Penna.	Dec. 1, 1942	Elmer Krall	Sept. 20, 1942
No. New Jersey	Dec. 1, 1942	Edward Gursky, Jr.	Oct. 15, 1942
West Indies	Dec. 1, 1942	Mario de la Torre	Dec. 16, 1942
Missouri	Dec. 15, 1942	Robert C. Morwood (resigned)	....
Eastern Fla.	Dec. 15, 1942	Carl G. Schaal (resigned)	....
Kentucky	Dec. 15, 1942	Darrell A. Downard	Apr. 15, 1940
Hawaii	Dec. 15, 1942	Francis T. Blatt	Feb. 28, 1941
Sacramento Valley	Dec. 15, 1942	Vincent N. Feldhausen	June 15, 1941
Nevada	Dec. 15, 1942	Edward W. Heim	Nov. 1, 1941
Oklahoma	Dec. 15, 1942	R. W. Battern	Nov. 1, 1941
Western New York	Dec. 15, 1942	Fred Chichester	Dec. 6, 1941
Southern Texas	Dec. 15, 1942	Horace E. Biddy	Dec. 23, 1941
New Hampshire	Dec. 15, 1942	Mrs. Dorothy W. Evans	Sept. 1, 1942
Utah-Wyoming	Dec. 15, 1942	Henry L. Schroeder	Oct. 1, 1942
Michigan	Jan. 15, 1943	Harold C. Bird	Feb. 3, 1943
Mississippi	Feb. 1, 1943	S. Benton Cain	Feb. 15, 1943

1. You are hereby notified that an election for an ARRL Section Communications Manager for the next two-year term of office is about to be held in each of these Sections in accordance with the provisions of the By-Laws.

2. The elections will take place in the different Sections immediately after the closing date for receipt of nominating petitions as given opposite the different Sections. The Ballots mailed from Headquarters, will list in alphabetical sequence the names

of all eligible candidates nominated for the position by ARRL members residing in the Sections concerned. Ballots will be mailed to members as of the closing dates specified above, for receipt of nominating petitions.

3. Nominating petitions from the Sections named are hereby solicited. Five or more ARRL members residing in any Section have the privilege of nominating any member of the League as candidate for Section Manager. The following form for nomination is suggested:

(Place and date)

Communications Manager, ARRL
38 La Salle Road, West Hartford, Conn.

We, the undersigned members of the ARRL residing in the...........Section of the......................Division hereby nominate..........................as candidate for Section Communications Manager for this Section for the next two-year term of office.

(Five or more signatures of ARRL members are required.)

The candidates and five or more signers *must* be League members in good standing or the petition will be thrown out as invalid. *Each candidate must have been a licensed amateur operator for at least two years and similarly, a member of the League for at least one continuous year, immediately prior to his nomination or the petition will likewise be invalidated.* The complete name, address, and station call of the candidate should be included. All such petitions must be filed at the headquarters office of the League in West Hartford, Conn., by noon of the closing date given for receipt of nominating petitions. There is no limit to the number of petitions that may be filed, but no member shall sign more than one.

4. Members are urged to take initiative immediately, filing petitions for the officials of each Section listed above. This is your opportunity to put the man of your choice in office to carry on the work of the organization in your Section.

— George Hart, Acting Communications Manager

ELECTION RESULTS

Valid petitions nominating a single candidate as Section Manager were filed in a number of Sections, as provided in our Constitution and By-Laws, electing the following officials, the term of office starting on the date given.

Eastern New York	Robert E. Haight, W2LU	Oct. 15, 1942
Northern Texas	N. R. Collins, Jr., W5IAU	Oct. 15, 1942
Virginia	Walter G. Walker, W3AKN	Oct. 15, 1942
New Mexico	J. G. Hancock, W5HJF	Oct. 15, 1942
Kansas	Alvin B. Unruh, W9AWP	Oct. 29, 1942

BRIEFS

W9HPJ, chairman of the Procedure Committee of the Illinois Chapter of Associated Police Communication Officers, Inc., rightly points out that geographical names used in phonetic-equivalent word lists are often confusing and that his national organization has deleted Boston, Chicago, Denver and New York, substituting Boy, Charles, David and Nora. We're not suggesting that you change your word lists at this late date, especially in view of the fact that the standard Western Union list we suggested originally is available in printed form — but there is room for argument.

Speaking of word lists, W3JVX sends in one which is entirely different from any we have ever seen — and we've seen (and heard) plenty! We are not suggesting that this list be universally adopted:

A for 'orses
B for mutton
C for yourself
D for dumb
E for puts you to sleep
F for vescence
G for police
H for himself
I for got
J for see a dream walking?
K for ances
N for mation
O for goodness sakes!
P for peifer picked a peck . . .
Q for billiards
R for itis
S for example
T for two
U for me
V for La France!
W for over-bidding
X for breakfast
L for bet
M for size
Y for the luvva Mike?
Z for breezes

The Month in Canada

QUEBEC — VE2

From Lin Morris, 2CO:

Congrats to George Hudson, 2CS, who was married October 17th, in Montreal. 2DU is now a lieutenant in the RCNVR (Special Branch), with headquarters in Ottawa. 2JR is a corporal in the RCAF and spent some time instructing in W/T at the Lachine Manning Pool. 2HM is a provisional second lieutenant (reserve army) with the McGill OTC and is studying for his qualifying exams. 2GE has won his second pip and has returned to Saskatchewan after a short furlough.

The following is a list of hams engaged in code instruction at air cadet units: 2KS at Verdun High School Sqdn; 3AKO at Griffintown Boys Club; 2NR at Montreal West High School Sqdn; 3HN at YMHA Sqdn; 2HM at St. Jean de Breboeuf College Sqdn; 2EM and 2IE at Westmount High School Sqdn; 2PW and 2CO at Villeray Sqdn. 2HI, after suffering a broken ankle this summer, is now back on the job teaching code to two classes of co-eds at Royal Victoria College.

Seen but not heard: 2CR, 2GN, 2FV, 2GE, 5TD, 3JI, 2AX, 2BE, 2DR.

ALBERTA — VE4

From W. W. Butchart, 4LQ:

4HM took some swell Kodachrome "stills" last month, and is now looking around for a projector. Anyone know where he will get one? They are at a premium here in Edmonton!

4XE's YF spent a month in Edmonton on sick leave and returned to her duties in Calgary at the end of September. XE has his hands full with a very large Part 1 Signalling School at the Prince of Wales Armouries. 4EA turned out a pip of a job on his dual-turntable outfit, which is really portable. Ray has the start of a nice record library, too. He has LQ interested to such an extent that the dual-turntable unit is well under construction and the amplifier is just undergoing tests for quality, etc.

4EA has been assigned a new job at CFRN. He will work out at the transmitter from now on, and Roy doesn't exactly relish the job! 4XF told us last night that the local hams (the few we have left), might get a chance to work on the ARP net that is contemplated in Edmonton. 4XF, by the way, is busy three nights a week and Sunday mornings taking the Garrison School course being held at the Prince of Wales Armouries.

Our old pal Mickey, 4WY, will be back in Edmonton before long — if rumor is to be believed, and we're pretty sure of this one. We understand that Mickey's OM has joined the RCAF as a mechanic. 4BW has quite a time with "priorities" and says that it is pretty hard to turn a brother ham down on lots of items!

We are sorry to learn of the loss of 4GY's son, killed in line of duty with the RCAF.

It's been a long, long time since we heard from any of the out-of-town gang, and this column as far as the writer is concerned is going to fold up if you don't kick in with a bit of news. How about that letter you were going to write? And how about a line from 4OF? Watsa, Ted?

That's all there is, boys. See you next month if there is any news floating around!

MANITOBA — VE4

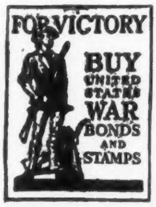
From Art Morley, 4AAW:

It's a disgrace, the way you guys keep me posted on what's what. Don't forget — no news, no column!

4QG, who has been out on the West Coast for some time, was in Winnipeg on a well-earned leave. 4YM has left for parts unknown with the Navy. 4ARX is recuperating from a spell of stomach ulcers. He should be around in a few days. 3PF has received a Commission with the Signal branch of the RCAF. 4BG has transferred from the reserve to the active army. He has the rank of lieutenant.

VO2N was stationed at Dafoe with RCAF, but recently left for "you tell me." 4FV, until recently with the Ferry Command, is now stationed in Winnipeg. He tells me 4AMS in Brandon is pining away for the OM, 4IF, who is somewhere "over there." 4TQ is in the motion picture business in Dauphin. 3AFH has left Portage, destination unknown. 2AAW and 4AJY are receiving the usual line on the addition of a junior op.

And that's all for now, but don't blame me. Remember, no news — no column!



We heard once of a camera manufacturer who had a lot of trouble because his customers oiled the shutters. This gummed them up so they would not work. The instructions said not to oil the shutter, but nobody read instructions. They tried to make the shutter so that it *couldn't* be oiled, but there is no thwarting a man with an oil can. Finally, so the story goes, a meek little draughtsman in the engineering department asked timidly if he might try his remedy. He put a little hole in the top of the shutter marked "OIL" and ran a small pipe from it to the outside of the camera. This worked fine, for the oil never reached anything except the user's fingers.

This story may not be true, but it certainly is timely. Some of our receivers have suffered rather severely at the hands of well-intentioned men who believed "a drop of oil will fix it." In these days of scarcity, when maintenance is becoming a fine art, a few pointers may be helpful. Tube manufacturers have given explicit instructions on the care of their product, so we will confine ourselves to receivers. Most of our suggestions apply equally to any receiver, and all are based on experience.

Contact trouble seems to be the cause of the oil can. A dirty contact is noisy, and oiling the contact reduces the noise — for a little while. The remedy for a dirty contact is to clean it with carbon tetrachloride or "Carbona." After drying, it may be lubricated with a very small amount of petroleum jelly or Vaseline. Do not use much, and never use oil. Oil creeps over the chassis, attacking rubber insulation and gathering dust. We have seen receivers with enough oil on the chassis to drown ants in.

This cleaning should be given to both rotor contacts and coil contacts. On the NC-200 and similar receivers, removing the cover of the cast aluminum coil shield and one set of coils will expose the coil contacts. On most other receivers little or no disassembly will be required. Needless to say, a dust cover over the receiver when it is not in use will help to keep it clean, but ventilation must be unrestricted when operating.

While on the subject of dirt, do not fail to keep the space between the condenser plates free from dust. An air jet is an easy and effective way to solve this cleaning job. If it is not available, pipe cleaners can be used equally well to brush the dust out, though it takes a little longer.

Be careful not to bend the condenser plates, either by accident or intentionally. On most condensers the final tracking adjustment is made by bending the outside plates on each section, so do not straighten them. It will ruin performance.

This is all we have space for this month, but we will follow on in the next issue of *QST*. In the meantime, we hope you will leave the oil can alone — and that goes for your camera, too.

Dick Gentry

Silent Keys

It is with deep regret that we record the passing of these amateurs:

J. L. Barrett, W5BNE, ex-W5BVX, Houston, Tex.
Minto Bradley, W9NCK, Marion, Ill.
Flt. Lt. W. L. Cameron, VE4PX, Edmonton, Alta.
Arlo D. Fee, W6BFA, Prescott, Ariz.
J. Douglas Fortune, W9UVC, Chicago, Ill.
Walter A. Graham, W2ADS, Lyndhurst, N. J.
Harrison Holliway, ex-6BN, Los Angeles, Calif.
Harold N. Hyde, W9TDK, Jacksonville, Ill.
Frank J. Kamlowsky, W7DEN, Billings, Mont.
Lloyd W. Lockwood, W6CRZ, Compton, Calif.
Quentin D. Moon, W9AAQ, ex-W6PMK, Denver, Colo.
Reginald Neale, G6GZ, Farnborough, Hants.
Lt. John E. Parson, W3EIO, Ardmore, Pa.
Carr A. Paxton, W8KAE, Brasher Falls, N. Y.
Edgar Rice, W9ITI/K7, Hatton, N. Dak.
Gordon L. Roach, W5CE, ex-W5CWL, Enid, Okla.
Albert Walter Tervo, ex-Can. 5CO, Victoria, B. C.

Correspondence

(Continued from page 73)

326 E. Maxwell St., Lexington, Ky.

Editor, *QST:*

. . . I am now working for the U. S. Army Signal Corps in a civilian capacity . . . attached to the Office of the Chief Signal Officer, Washington, D. C. I am now at Lexington attending the Signal Corps School. After some training here I am to go back to Washington and from thence to most any place.

I secured the position through an item in the "U.S.A. Calling" section of *QST*. . . .

I would like to thank you for any effort you have expended in my behalf and feel that I have found my place for the duration. . . .

— Carl C. Trout

148 Longview, Decatur, Ill.

Editor, *QST:*

Through *QST* registration I received a Civil Service appointment with the FCC as radio operator in the radio intelligence division. . . .

— Charles E. Bailey, W9HUX

(Continued from page 78)

1121-B 14th St., Santa Monica, Calif.

Editor, *QST:*

I want to take this opportunity to thank you and at the same time remove my name from your personnel availability list.

I have secured an excellent position in the radio field through your efforts, and again I say thanks.

— Leonard C. Tate

---

1 Fenwick Court, Hastings-on-Hudson, N. Y.

Editor, *QST:*

I would like to take this opportunity of expressing my appreciation for the assistance which I have received from the League in obtaining radio war work.

About three weeks ago I was approached . . . with reference to becoming a field engineer.

I am very happy to inform you that satisfactory arrangements have now been made for my employment and I will begin a brief instructional course on Monday. . . .

Thank you for your part in the above.

— Gerald S. Bean, W2KQO

Editor, *QST:*

I wish you would remove my name from the roll of men available, as I'm now employed by the Aircraft Radio Laboratory . . . and like my work very much.

Thanks a lot for referring them to me, and hoping I can help you as much in the future.

— Clare B. Reynolds, W9MBI

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205 W. Forrer Blvd., Dayton, Ohio

Editor, *QST:*

As I have accepted a position in radio at Wright Field you may remove my name from the personnel availability list. I join many others in complimenting you on the fine work you are doing for "we, the hams."

— Baron B. Barker, W9UOF

---

826 Cleveland Ave., Bridgeport, Conn.

Editor, *QST:*

Please remove my name from your list of persons available for change of position.

The General Electric Co. hired me. I am in the test maintenance department where we build and maintain the test equipment used to check the radio products made by G.E. for the Army and Navy. . . .

Thanks very much for your aid in assisting me to secure a better position.

— Eugene B. Canman

AND GOING STRONG

University of Vermont, Burlington, Vt.

Editor, *QST:*

. . . I'll take up that wager of Lt. Col. Claude

(Continued on page 82)


WELL, MOTHER, NOW THAT JUNIOR HAS JOINED THE SIGNAL CORPS, I GUESS I'LL LEAVE THE OLD STORE AND GET A JOB IN ONE OF THE WAR PLANTS
YES, ELMER, I'VE BEEN THINKING ABOUT THAT TOO. WE'LL BOTH GET WAR JOBS
THERE ARE MANY OTHER THINGS THAT WE CAN DO AND DO IMMEDIATELY TO HELP THE MANPOWER PROBLEM
FROM PRES. ROOSEVELT'S SPEECH

(Continued from page 80)

H. Oliver, W6FPF, (p. 26, Nov. *QST*) that he is up on top in age of hams in active service. I have him beaten by a mere 1) years!

— *Major H. G. Wyer, W1ICI*

A DUTY TO JOIN

6923 Atlantic Blvd., Bell, Calif.

Editor, *QST:*

After reading the Correspondence page in *QST*, I decided that it was about time that I joined the League. I have been meaning to join ever since I first became interested in amateur radio, back in 1937. But I didn't want to join the League until I had obtained my Class B ham ticket, so I kept putting it off. After receiving my ticket on October 6, 1941, I put what little cash I had into parts for a rig on 2½ meters. I worked on 2½ up to December 7th, making a total of 71 different contacts, but still had not joined the League. After the war broke out I more or less lost interest. But after reading the articles written by W8VQV and W2OCP, I decided that it was my duty, as a licensed radio amateur, to stand back of the League that has done so much to help ham radio in this, the land of the free. . . . I can now proudly say that I am a member of the American Radio Relay League. . . .

I would like to add my comments on the matter of QSLs. In my enjoyable two months on the air I QSLed to approximately 25 out of the 71 that I worked. I received in return 12 QSLs which I am very proud of. We, however, cannot expect to receive QSLs unless we send them. . . . I would like to make a standing offer to anyone in the United States. This offer is that I would like to exchange QSLs with you. I was not on the air long enough to work any great DX, and so I have never been able to obtain any QSLs from any other district, except for one from W7IRO, who was portable 6 at the time of the contact. I can see that this is one way of keeping an interest in the rest of you fellows. . . . So, if any of you twenty thousand want to swap QSLs with me, I will be only too glad to mail you mine.

— *Fred A. Reed, W6UMC*

HELP OTHERS TO STAND

Route No. 4, Alliance, Ohio

Editor, *QST:*

I am not a licensed radio amateur but I certainly wish I could be.

I wrote this letter to congratulate you on the fine work you are doing to keep *QST* coming off the press. This is the most important time ever for all amateurs to stick together. I guess they are all beginning to realize how important ham radio is to them, since they were all ordered from the air.

Amateurs should stick together like old pals, now, because each one, individually, helped the next guy to his feet, to where he could stand up in amateur radio.

— *Robert Hons*

AS TOUGH AS THE MEN WHO USE THEM!
Our fighters are tough! They must be when, midst the rhythmic whine of bullets . . . the strident din of roaring cannon, they are face-to-face with a treacherous, ruthless enemy. Their rigorous training must provide them with superior fighting qualities. As in men so in Microphones. They, too, must be tough to match the rugged fighter. Microphones made by Shure Brothers *are Tough* because they have survived tests in engineering and production more destructive than conditions they meet in service. Truly a fighting pair serving the cause of Freedom . . . the fighter and his "Fighting Mike."
SHURE BROTHERS
Designers and Manufacturers of Microphones and Acoustic Devices
225 West Huron Street, Chicago
SHURE

How's Your Math?

(Continued from page 37)

the number is multiplied by the power and the antilog taken. To extract a root of a number, the log of the number is divided by the root and the antilog taken. In the case of raising to a power or extracting a root, the multiplying or dividing may also be done with logs. This will involve taking the log of a log or "log log" of the number as it is called. Table III gives a summation of these operations.

Examples

Ex. 1. To multiply 3.42 by 60.8

$$\begin{array}{rl} \log 3.42 = & 0.534 \\ \log 60.8 = & \underline{1.784} \\ \text{Addition} & 2.318 \\ \text{Antilog (answer)} = & 208 \end{array}$$

Ex. 2. To divide 3.42 by 60.8

$$\begin{array}{rl} \log 3.42 = & 10.534 - 10^{*} \\ \log 60.8 = & \underline{1.784} \\ \text{Subtraction} & 8.750 - 10 \\ \text{Antilog} = & 0.0562 \end{array}$$

Ex. 3. To multiply 0.0342 by 60.8

$$\begin{array}{rl} \log 0.0342 = & 8.534 - 10^{**} \\ \log 60.8 = & \underline{1.784} \\ \text{Addition} & 10.318 - 10 \text{ or } 0.318 \\ \text{Antilog} = & 2.08 \end{array}$$

Ex. 4. To raise 60.8 to the 3.42 power or $(60.8)^{3.42}$

$$3.42 \times \log 60.8 = 3.42 \times 1.784$$

If we perform the multiplication by logs also, then we shall have to take the antilog twice.

$$\begin{array}{rl} \log 3.42 = & 0.534 \\ \log 1.784 = & \underline{0.251} \\ \text{Addition} & 0.785 \end{array}$$

Antilog = 6.10 (Result of 3.42×1.784)
Antilog = 4,070,000 (Result of $(60.8)^{3.42}$)

Ex. 5. To extract the 3.42 root of 60.8 or $\sqrt[3.42]{60.8}$.

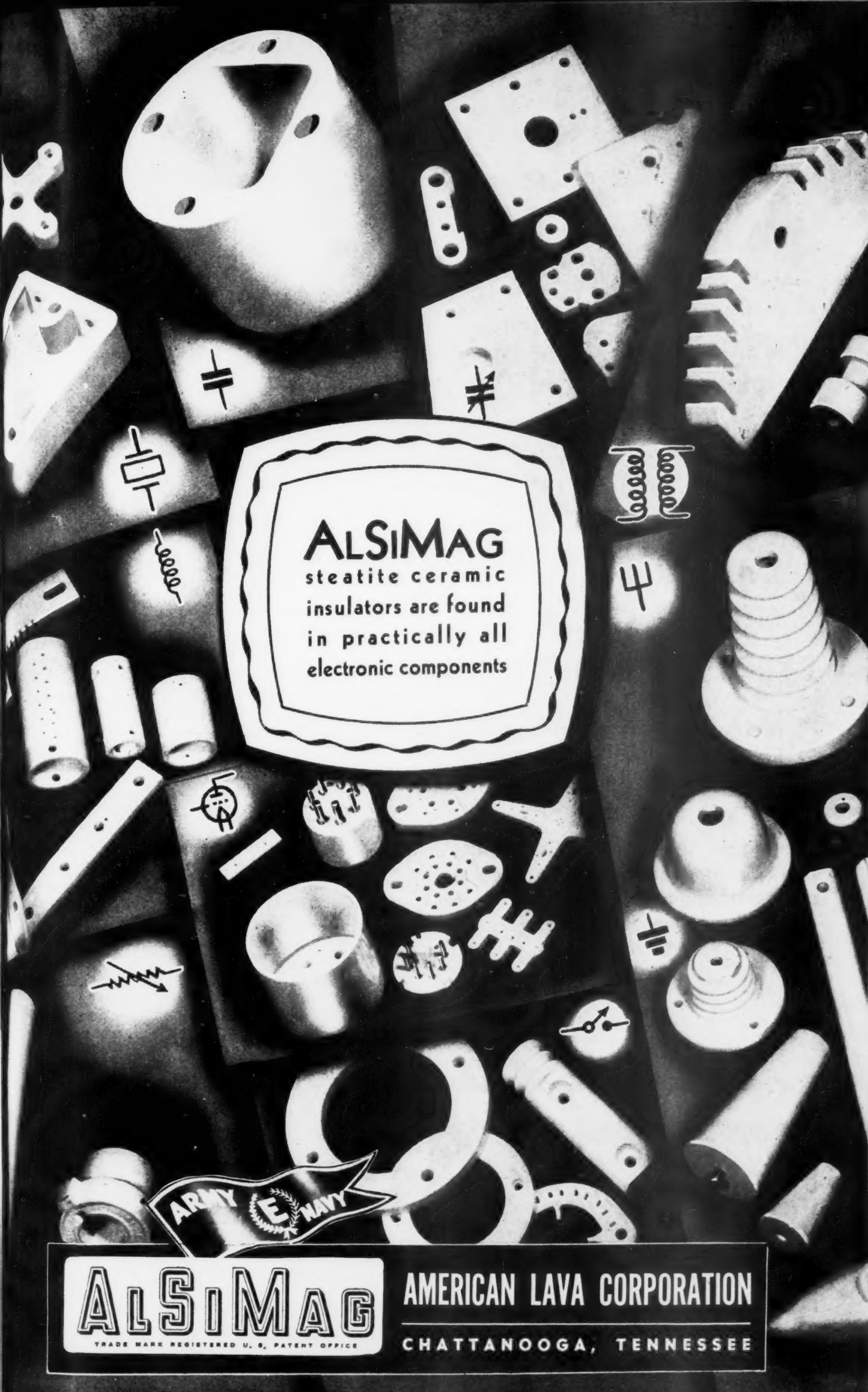
$$\frac{\log 60.8}{3.42} = \frac{1.784}{3.42}$$

$$\begin{array}{rl} \log 1.784 = & 10.251 - 10 \\ \log 3.42 = & \underline{0.534} \\ \text{Subtraction} & 9.717 - 10 \\ \text{Antilog} = & 0.521 \\ \text{Antilog} = & 3.32 \end{array}$$

(Continued on page 86)

* In this case it is necessary to add and subtract 10 to the characteristic as shown. This is a standard procedure for this type problem.

** Here the characteristic is actually negative and is most conveniently expressed in the manner shown. Using our rule one plus the number of ciphers in this case is two which makes the characteristic — 2 or 8 — 10 where the — 10 is written to the right as shown.


ALSIMAG
steatite ceramic
insulators are found
in practically all
electronic components
ARMY E NAVY
ALSIMAG
TRADE MARK REGISTERED U. S. PATENT OFFICE
AMERICAN LAVA CORPORATION
CHATTANOOGA, TENNESSEE

(Continued from page 84)

Ex. 6. To solve the following problem

$$\frac{(2.41)^{6.1}\,(39.0)}{\sqrt[3.1]{523}}$$

In this example the simple multiplications and divisions were done by longhand:

Numerator —

$$\begin{aligned} 6.1 \times \log 2.41 &= 2.33 \\ \log 39.1 &= \underline{1.59} \\ \text{Addition} \quad & \ 3.92 \end{aligned}$$

Denominator —

$$\frac{\log 523}{3.1} = \frac{2.72}{3.1} = 0.876$$

Combining the numerator and denominator —

$$\begin{aligned} \text{log numerator} &= 3.92 \\ \text{log denominator} &= \underline{0.88} \\ \text{Subtraction} \quad & \ 3.04 \end{aligned}$$

$$\text{Antilog} = 1100$$

On the Ultrahighs

(Continued from page 69)

dressed as follows: Pvt. G. C. Mallory, Co. E, 1st Sig. Corps Training Battalion, Fort Monmouth, N. J.

Pvt. Russell A. Law, W4EKN, was one of our more active W4s, having been one of the mainstays of 56 and 112-Mc. work in Atlanta, Ga. At this writing he is in the hospital at Monmouth, having sustained a leg injury during the basic training period. His address: 1st Battalion, Signal Corps Training School, Co. G, Fort Monmouth, N. J.

W3AXU, Trenton, N. J., writes that he is engaged in work which is secret in nature. He reports that his tower, which was pushed around by the wind last spring, has been re-erected, and is now serving for f.m. antennas.

W2LAL, West Englewood, N. J., is now doing civilian work for the Signal Corps, duties and location to remain unpublished. His home address remains as listed in the *Call Book*.

Frank Grey, W9LLM, writes from La Mesa, Cal. (5141 Randlett Drive) that W9VZP, formerly of Chicago, is now working in Delavan, Wis., and living at 133 Fowa St. Frank also passes along the information that gossip has hit the West Coast to the effect that our champion worker of states on Five, W9ZHB, Zearing, Ill., has taken up croquet and is challenging all comers!

Strays

Sam: "It's got so now that half the world doesn't know how the other half lives."

Ham: "That's because we're off the air." — *The (N.C.) Arc.*

How Recordings Are Made

(Continued from page 55)

ting — has been emphasized. Below 65° F. the coating becomes too hard to cut properly. For high-quality work cutting should be done only at room temperature; in fact, the transcription studios are very carefully regulated as to temperature, with only fractional-degree variation either summer or winter.

Not only is the blank affected by temperature, but the characteristics of the cutter and pickup are as well, particularly if crystal types are used. The internal capacity of a typical crystal element has a great temperature dependence; it is a maximum at room temperature (72° F.), dropping off quite rapidly in either direction (from 0.005 μfd. at 72° to 0.003 μfd. at either 60° and 85° in a typical case), resulting in as much as 6 db. variation in sensitivity over that range. While this variation is minimized in modern "bender" elements of the Bimorph type, and can be further reduced by series-condenser compensation (as pointed out in the previous discussion of equalizers), it is still a factor to be considered.

Humidity is more of a problem in connection with the blank than it is with the cutter, since modern crystal elements are thoroughly waterproofed and sealed.

Returning to the stylus, a good bit has already been said about its adjustment, the correct cutting angle, etc. The beginner should study this material carefully and practice making cuts under various conditions until he acquires the "feel." Experienced operators can adjust a stylus almost by instinct; they know from the appearance of the groove and the chip and the way the thread curls whether or not the cut is right. A new cutter will be adjusted during a test cut, the angle being changed until the thread lies straight, with no tendency to spiral, throwing up away from the head toward the center of the record. Once the thread looks right, the adjustment is done.

All of this assuming that the stylus itself is sharp, correctly ground with enough back rake to throw the thread up and to center, and otherwise properly made. A good stylus is essential to good recording, of course, and when you have a good one every effort should be made to preserve it. Not only must it never be allowed to drop on the record, but it should be protected against accidental banging when not in use. Even when stored, it is a good idea to wrap the stylus — particularly if it is a jewel type — in cotton, rather than allow it to rattle around loose in a box.

Monitoring

One of the secrets of better-than-average recording is skillful monitoring. Monitoring has two purposes: first, the technical one of restricting the peak modulation amplitude to the maximum permissible depth, and second, the esthetic one of securing interesting and pleasing entertainment effects. In this discussion we are, of course, concerned only with the first purpose, but the second

(Continued on page 90)

(*Continued from page 88*)

is mentioned to emphasize the desirability of having adequate monitoring facilities in any recording installation.

A monitoring system is, of course, a means of listening to what is being recorded — preferably simultaneously with the actual cutting. The prime qualification of a monitoring system is that it have fidelity and quality at least equal to that of the associated recording system. It should receive its signal from a point as close to the actual cutting head as possible, yet it must not interact in any way with the performance of the record.

The simpler recorders merely use a monitoring loudspeaker, deriving power for it from the recording amplifier, while the better installations use an intermediate wide-range isolating amplifier. Typical circuits involving use of the speaker alone are shown in Fig. 3. The simplest possible arrangement for a magnetic cutter is shown in Fig. 3-A, merely involving switching from the cutter to a speaker having a voice-coil impedance similar to the cutting head. This circuit does not, of course, provide simultaneous monitoring.

The circuit at Fig. 3-B does allow listening while cutting, the monitor-speaker level being reduced to comfortable volume by the shunt resistor, *R*. This resistor also minimizes the impedance vs. frequency variation in the voice coil which would otherwise affect the cutter performance.

Where the amplifier is to be used for both recording and playback, the circuit of Fig. 3-C is useful. When the switch is set for recording the circuit is the same as (B), except that the cutter also has resistive loading, while in the playback position the cutter is shorted out and the shunt resistor removed from the speaker to permit full output.

A satisfactory monitoring arrangement for use with a crystal cutter is shown at Fig. 3-D. The output transformer primary serves as a coupling choke, as described in September *QST* (Fig. 5-D, p. 71), the voice coil feeding the speaker in normal fashion. Again a shunt resistance on the speaker may be used to regulate volume and help stabilize the amplifier load.

Volume-Level Indicators

Of importance equal with monitoring is the provision of a suitable volume-level indicator, as was stated in the treatment of amplifiers. That discussion brought forth some inquiries concerning suitable circuits. Accordingly, a few of the simpler circuits are shown in Fig. 4.

Perhaps the simplest and most economical is the neon-bulb flasher illustrated at Fig. 4-A. The variable resistors are used to set the peak potential required for ignition at the desired point. Either single or dual bulbs may be used; with the dual arrangement one bulb is set to flash when the amplitude exceeds the safe maximum while the other is ignited whenever the modulation reaches the minimum required for satisfactory signal-noise ratio. The "low" bulb may be painted green or white and the "high" bulb red;

(*Continued on page 92*)


the Message to Garcia
carried from Washington to Cuba under almost insurmountable difficulties . . . An epic in American military history!
Today, 44 years later, the U. S. Army Signal Corps is delivering "Messages to Garcia" in a matter of split seconds as a matter of simple routine. But the tradition of high achievement remains symbolic of the U. S. Army Signal Corps. Now they daily accomplish feats of epic proportions with the use of modern communications equipment. Jensen is proud to have contributed to the design and production of some of this equipment.
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Join the U. S. Army Signal Corps!

(*Continued from page 90*)

in operation the technique then is to keep the amplitude such that the green bulb flashes constantly and the red bulb only intermittently or not at all.

Fig. 4-B is for use with a meter-type indicator. It conforms with one of the important requirements for a recording VI — that the indicator be connected as close to the recording head as possible. The a.c. voltmeter may be either a copper-oxide or vacuum-tube rectifier type; the standard copper-oxide "DB" meter calibrated for 6 mw. zero level on a 600-ohm line is commonly used. If a 500-ohm magnetic cutter is used, or a 600-ohm output transformer with primary-choke coupling to a crystal cutter, the db. calibration can be read directly. If desired, a tapped multiplier may be incorporated to extend the useful range (indicated by the variable resistor *R* shown in dotted lines). In using this circuit, the precautions concerning meter inertia and overswing discussed in an earlier installment should be borne in mind.

The preferred circuit for a meter-type indicator in connection with a crystal cutter is shown in Fig. 4-C. Here again the meter is arranged to read the actual signal at the cutter head. *R* is, of course, the multiplier resistance required to give the proper scale range. A 0–150 volt scale is ample for most cutters, although 0–250 volt swings may be permissible with some.

A variety of other VI arrangements may also be used — including single or dual "magic-eye" (electron-ray tube) indicators, rectifier-amplifier type vacuum-tube voltmeters, etc. The ideal is, of course, the cathode-ray oscilloscope. For the most part these more elaborate indicators must be designed to meet the requirements of individual installations, and it is not practical to attempt to show simple circuits.

Amplifier Construction

Testing and trouble-shooting the recording amplifier involves so nearly the same problems as in any ham speech amplifier or modulator that there is little additional to be said on the subject. At the risk of repetition, however, a few constructional pointers might be noted.

First, because amplifier hum can cause other complications besides its appearance on the record as a simple modulation frequency, it must be eliminated as completely as possible. All input circuits should be kept compact and thoroughly shielded, with all leads made short, covered with shielding braid and grounded. This is particularly true if the amplifier is located near the motor field; the input volume control (and mixer controls, if any) should then be mounted in shield cans and the leads completely encased in braid. It is usually best to make all input ground returns to a common point. Connecting cables for crystal-type cutters and pickups should be kept as short as possible.

Equalizer circuits are notorious trouble makers from the hum standpoint; components and connecting leads should be arranged for minimum

(*Continued on page 106*)

AMATEUR ACTIVITIES

ATLANTIC DIVISION

EASTERN PENNSYLVANIA — SCM, Jerry Mathis, W3BES — Our Section has lost one of the most active of its amateurs, 3FRY. He was the main spring of the Frankford Radio Club and contributed largely to that organization's excellent showing in competition since he joined. He is going to be asst. plant supt. in a tool-making plant near Detroit. His friends held a miniature hamfest in his honor before he went west. 3ENH has another YL in his family. 3GYV, a sergeant in the Army, was married recently in Florida to a Philly girl. 3EWJ is an Air Corps lieutenant at Randolph Field, Texas. 3EYS received a first lieutenant's commission in the Signal Corps and is stationed at Brooklyn. 3HSR is a 2nd lt. in the Signal Reserve at Duncan Field, Texas. He was married recently. 8TOD is an instructor at the Middletown Air Depot Electrical School in the Civil Service. 8MFD is an air raid warden and an aircraft spotter. 8BFF has enlisted in the Navy. 8PUZ has an E.E. degree from Cornell but was unable to enlist because of poor eyes, so the draft got him and he was sent to New Cumberland for induction. We suppose he will go to a Western radio school. 8PTE has three sons in the Army and a fourth about ready. He tried to enlist but he is 54 years old and the Signal Corps says nothing doing. To make matters worse the railroad for which he was working has been torn up for scrap. 8OHT made a trip to Iceland on a freighter and is now working for an airline at Baltimore. Many thanks to 8PTE for all the W8 dope. All the ECs whose terms have expired have been contacted by 3DVC, Asst. SCM in charge of EC work and we find that ECs are needed for the counties of Montgomery, Bucks, and York. WERS licenses have been issued to the townships of Lower Merion, Haverford, and Marple. There have been several meetings in Phila. with regard to the WERS license but to date the license has not been applied for. We hear that there is a lack of equipment and operators, and that they wish to get everything set up before application is made rather than bother with modifications afterward. 2MWK called on the phone to advise that he is with the Signal Corps school in Phila. and that he was affiliated with the WERS in NYC. He has an Abbott TR4 and is building an emergency 6 volt supply. 2LXI, active ORS of N. N. J., is in Phila. in a Navy training school. 6NAE, operator at the famous 6YX at Stanford Univ., is teaching radio at the Chamberlin Aircraft Corp. 4AIH dropped in from Alabama to say hello. Although from S. N. J. across the river, 3ASG is so well known in E. Pa. that we must tell the gang he is off to the wars again. 3IGK is acting inspector in charge of the local FCC office. DOR is with the FCC in Phila. and the YF is trying to be a junior radio engineer in the Signal Corps Depot. 3HXA has been advanced to second in command in the Westinghouse X-ray service and installation. 3BXE dropped in on 3FRY's farewell party from N. Y. C. 3JBC, IXN and BES helped tear down a lot of DX represented by 3FRY's big antenna. 3IGK, HFD and DOU are building startling new superduper 2½-meter superhet receivers for use in the WERS. 3IXN has a WERS rig with a handle on it, complete even to built-in fluorescent lighting. 3FRY beat 3QV's 2000 lbs. of radio junk by about a thousand pounds. He also had about 300 pounds of scrap for the scrap campaign. 3FLH donated his steel antenna mast and relay racks to the good cause. 3RR endorses the idea of wearing call pins, since there are so many hams on the loose known to each other only by calls. Keep the dope coming. 73. — *Jerry*, W3BES.

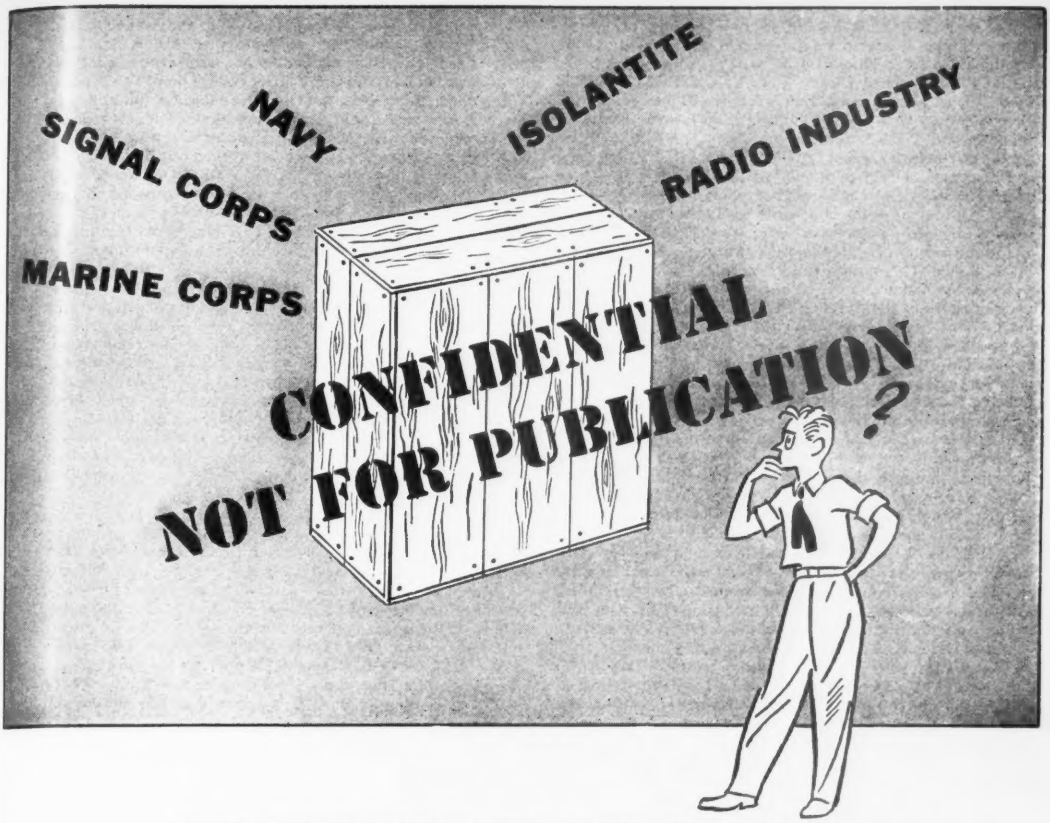
MARYLAND-DELAWARE-DISTRICT OF COLUMBIA — SCM, Hermann E. Hobbs, W3CIZ — The Washington Radio Club held a meeting on Sept. 26th at its new meeting place, Central YMCA, 18th & G Sts., N.W., Washington. All future meetings will be held at this new location. A club party was held on October 24th at the Central YMCA. 8HMH is attending the Naval Instruction Class at the Bliss Electrical School, Takoma Park, Md. 73.

SOUTHERN NEW JERSEY — Acting SCM, W. Ray Tomlinson, W3GCU — Asst. SCM, ZI; Regional Coördinator in charge of Emergency Coördination, BAQ; Emergency Coördinators: Atlantic City, EFM; Camden, KW; North Plainfield, CGU; Vineland, GMY; Somerville, EBC. By the time this reaches the *QST* column our former SCM, CCO, will have completed his officer's training at Miami Beach, and been transferred, as far as we know, to Bowman Field, Louisville, Ky. ABS reports that 2LO has been appointed technical advisor, or communications officer, for New Brunswick with working agreement with Highland Park, N. J. They have equipment set up and ready to go and are ready to apply for WERS license. Activity will be confined to New Brunswick and Highland Park for the present, but may later include South River, Bound Brook and possibly Somerville, N. J. Somerville has five or six hams with equipment ready to go in addition to ACC and ABS who are active communications officers in their respective townships of Hillsborough and Branchburgh. ABS has suggested joint meetings of all amateurs, ECs or technical assistants in that entire area to complete WERS organization. ABS is building another 2½ meter transverter for use of Hillsborough Twp. WERS. ABS' summer radio school has finished, and Stan is planning to start fall and winter sessions about last week in October or first week in November and expects to train third class 'phone ops for WERS as well as new hams. The school will be known as the "Hillsborough Twp. Radio School" and will teach code as well as theory. ASG reported October 9th for active military duty as a captain in the Dental Corps of the U. S. Army. ASQ reports that the Hamilton Twp. radio class is progressing nicely. ASQ has been appointed as radio aide in charge of WERS organization and operation for Hamilton Twp. and reports that several pieces of equipment are on hand ready to go, including a crystal controlled job for control station. Fourteen amateurs and several students are participating in the movement for the Twp. and are preparing to make application for WERS permits in near future. This group is fortunately enjoying the whole-hearted coöperation of all Twp. officials in this project of which Mr. Frank Priest is communications officer-in-charge. So much for the few reports that we have this month. I refuse to believe that all activity is confined to a very small area of the Section. There are very active groups in other portions of the SNJ Section, let's have the dope on what's going on. Come on Morristown, Camden, Haddonfield, we know you are not sitting on your hands. Help keep the column going, drop your reports in to GCU by the fifteenth of each month. Till next month, 73.

WESTERN PENNSYLVANIA — SCM, E. A. Krall, W8CKO — Asst. SCM in charge of EC, AVY. WERS work is getting into swing in the W. Pa. Section and many of the gang are working on 2½ meter equipment so that when things get going they will be prepared to do their utmost towards assisting in CDC communications. A definite program is expected to be available sometime in December. A committee of three from Allegheny County met at the office of Mr. Myers, chief engineer of KDKA and radio aide for the County, to start the ball rolling by getting things in order for the rest of the gang. Mon-Yough Club of McKeesport has the following men in service: QFL, IZG, JSY, AJV and TFT. A good showing for the club. MXD is an ATA member who has recently entered the armed forces. KWA is now at Washington, D. C. We hear Richeimer, BSO, has gone in for ponies. Code classes are the vogue in this Section. PER is the latest to enroll 30 for a new class. He has also signed two more stations for WERS, MKO and HY for 112 and 224 Mc. One way for a fellow to keep his wrist oiled is to start a code and theory class. It is loads of fun and improves a fellow's estimate of himself. He really finds out what he knows, or does not know, and sometimes the knowledge gained by instructing a class brings up points which are of real assistance to the instructor, for it clears up points which troubled him more or less for a long time but he never took time to dig out the answers. Your SCM has found it out. At present his class is going at 20 w.p.m. and that's what can be done with a bunch of rookies who a short time ago thought they would never remember the code. Let's hear from the old ORS gang and get some real news for this monthly report.

CENTRAL DIVISION

INDIANA — SCM, LeRoy T. Waggoner, W9YMV — NXU was married Sept. 18th. RYF has new jr. op. JJC was elected vice president of the Indianapolis Radio Club to complete the term of FOS, now at Fort Monmouth. DGA is now with an M.P. Bn. at Fort Harrison, Indiana. BJT has



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had to resign as radio aide of Mishawaka because of serious illness. AB has taken up his duties. YWE is teaching radio for Signal Corps at Chicago. ENJ is now a sergeant at Bolling Field. KHB is new EC at Crown Point. 7BGM/9 is now with G.E. at Fort Wayne. 9NVA reports Richmond Radio Club very busy with code school, classes for restricted radiotelephone and WERS procedure training. The YLS took the honors in the latter, Dick says. LVT visited NVA recently and discussed WERS problems. ZFR is recuperating from operation. EHT says the Signal Corps has been able to buy a lot of equipment from the hams in Terre Haute. MJW worked up foolproof, low-cost design for WERS transmitters at Mount Vernon. Lieut. Walter V. Mentzer of the Indiana State Police, Communications Coördinator for Indiana, assisted by Zellon Audritsh, also of the ISP, have been making tours of the State to foster interest on the part of local defense authorities in WERS. The response has been very gratifying, except that it has shown that we are weak in certain localities. If there is no Emergency Coördinator in your area, please drop me a card and volunteer for the job. Several Indiana Defense Councils have indicated to me that they would appreciate the help of hams in their localities to assist in the formation of WERS units. Most of these requests come from communities not represented by ECs. If you are in doubt about whether your community is represented, drop me a card, and I'll be glad to forward information. Which will be the first Indiana community to have its WERS license? 73. — *Roy*, W9YMV.

MICHIGAN — SCM, Harold C. Bird, W8DPE — FX is still selling bugs and has sold 21 to date. UGR has tried for his class A, is also going out for commercial. CW is teaching a radio class in his off hours. DSQ is still marking time and doing woodcraft work. The Oakland County and Pontiac Civilian Defense Council is arranging a meeting with state officials to talk over the possibilities of using WERS in this area. Looks very favorable so far. The DARA and Detroit Edison club have their radio classes going very strong now with forty students. They are in need of instructors. Anyone with ham or commercial tickets or SLWs are requested to get in touch with Ken Conroy, DYH, 'phone Pingree 2779. They would appreciate hearing from the members of the other radio clubs to help in this worthy cause. Saginaw Valley reports things progressing very rapidly in that section with several complete units available for WERS. They also are training men for naval and CAP work. Lansing gang all set and waiting further instructions from their local OCD to proceed with final work to set the WERS in motion. Muskegon still assisting their local OCD with teaching radio and laying plans for the development of WERS units. Grand Rapids is also getting equipment and personnel in readiness for the adoption of WERS in that locality. Would appreciate hearing from other parts of the section as to what progress is being made for the adoption of WERS. 73. — *Hal.*

OHIO — SCM, D. C. McCoy, W8CBI — WERS license has been received by Piqua. NAB reports the Bellefontaine gang is starting a new code class September 28th. TQS has been appointed chief radio aide for Cincinnati Metropolitan Region, Citizen's Defense Corps; VND and UPB have been appointed deputy radio aides to assist him. Applications for WERS license are in preparation and applications for WERS operator's permits are being prepared. TAD has been appointed radio aide for the Youngstown Warning District. On his recommendation TGA has been appointed EC for Warren, Ohio. Youngstown is planning a course of instruction for 3rd class radio-phone licenses and will start a class in code and theory if sufficient interest exists. NPZ has resigned as EC for Springfield, anticipating joining the Army in the capacity of a radio instructor. Successor not yet appointed. UJB has resigned as EC and radio aide for Akron to enter the Army. LUT has been appointed EC and radio aide for Akron. PLI, VTY, KOL and WRY have joined the Emergency Corps from the Cleveland area. Welcome, gang! We need more AEC members in every town. The war is thinning our ranks and leaving us badly depleted to carry on our WERS programs. PUN reports the Ohio River Net not dead, just busy. LKU is supervising and EUN and PUN teaching ESMWT radio for Ohio Univ. WERS license has not yet been received for Dayton. However, work on 2½ meter equipment is going forward. Plans under way to reopen code instruction again this fall, and to train some graduates from last season's classes for 3rd Class 'phone tickets for WERS operators. DMN is heading educational activities. RHH, ex-CFW, DED, CBI and GCG provided code instruction for a class of glider pilots in the enlisted reserve of the Air Corps being given ground school training at the YMCA college. This class was graduated and sent to flying school for air training early in September. A new class has just started and will be trained by the same group. RHH is also teaching theory for the YMCA college now. The Miami Valley Emergency Net, the Old River Radio Club and the Dayton Amateur Radio Association have decided to combine their bulletins for the duration of the war. A State WERS plan of operation has been worked out by the Communications Committee of the Ohio State Council of Defense, and the Emergency Coördinator organization in the State of Ohio will be reorganized by the SCM as soon as possible to conform to this plan. CBI has been appointed as amateur radio's representative on the Communications Committee of the State Council of Defense. In assuming the duties of SCM, CBI appeals for coöperation of all amateurs in the State of Ohio. It is especially important that Emergency Coördinators make every effort to have their reports in by the 16th so that a consolidated report can be prepared in time for headquarters. Would also appreciate being placed on the mailing list of all affiliated clubs to receive their bulletins so that I can keep in touch with amateur activities within the State. Details of the new Ohio State WERS plan will be issued to Emergency Coördinators as soon as possible, and they should take steps immediately to revise their organization in accordance with this plan.

WISCONSIN — SCM, Emil R. Felber, Jr., W9RH — LGJ writes that GIY is now instructing at radio school in West Palm Beach, Fla. The Signal Corps school at Ashland was organized by the Ashland Vocational School with able assistance of BH, who has accepted the position of professor of chemistry at Knox College, Galesburg, Ill.; therefore EMB is now acting supervisor of the school. The following hams are instructors at the School: JBF, RQM, LGJ, DIE, YMY, GIT, PCO, 8AVO and R. Bruder. Of the 250 students now attending the school the following are hams: PKT, VXB, PHM and RQJ. GPI, supervisor of the Shorewood Opportunity School radio code and theory classes reports they have a full house at present with a waiting list of over 100 names. The classes, which are open to all, include YLs and OMs from 60 years old down to 16. Jack reports the effort and progress made by the students is astounding. The code classes are two nights per week, 7:30 P.M. to 9:30 P.M. with CCD doing hand sending and the theory class conducted once a week (same time) by HWO. The ARRL Handbook is used. The MRAC is planning another class as soon as a central location can be obtained. SYT reports NY and CDY are making progress in selling WERS to the local officials. Still more 2½-meter gear is needed. Call or see SYT if you have parts or 2½-meter equipment to lend Milwaukee for WERS. LED reports via OBZ that RLB is at Fairbanks, Alaska, and the Wausau hams teaching code at Madison are KXK, FZC, IJB, WTD and GNX. OBZ is now located in Milwaukee. ALG finished a new portable transceiver to be used for WERS and informs us that ZVO is a jr. radio instructor at AAFTS, Madison. DIJ is a sgt. and his QTH is 575th Signal Aircraft Battalion Separate, Drew Field, Fla. JWT is getting radio engineering and electronics at Harvard, and sends greetings to the MRAC. ANA writes his work as a glider instructor is interesting. CDY, president of the MRAC, wishes through this column to extend the club's Xmas and New Year's greetings to all the boys in the services. This also goes for your SCM. Wanted — MORE NEWS. Please write. 73. — *Emil.*

DAKOTA DIVISION

NORTH DAKOTA — SCM, John W. McBride, W9YVF — IEZ is now class A with a new "kilo" collecting dust; his new call is 7JCU and he is keeping busy at KYZY at Missoula, Mont. RPD is with Signal Corps at Dayton, Ohio. MCV and YOY are going to Illinois Tech. at Chicago. RPJ last heard of from Philadelphia. QGM is in Kentucky, the family with him. YVF is student instructor at Air Force Technical School at Sioux Falls, S. Dak. UGM is at Scott Field A.F. radio school. Bismarck hams report that they think October *QST* gave the state swell coverage — thanks a lot — give me a little help by mailing me a card or letter by the 10th. Wayne Griffin of Bismarck is up for ticket; he has been assigned a crack announcer berth with NBC. DHG is now staff sgt. with Coast Artillery in Santa Monica. ZRT is raising ducks. Let's have a duck dinner, Doc — you bring the duck! SSW is experimenting with carrier current gadgets but misses his part RBS who, it seems, has left for parts unknown. Brigadier-General L. R. Baird, Director for State

OCD, has expressed his interest in WERS. Your SCM has appointed SSW, John S. Glass, 409 12th St. So., Bismarck, as EC, and will appreciate it if all that possibly can will list their equipment with him, asking that he send them full particulars. This may be a chance for N. Dak. hams remaining at home to do their bit with the OCD. SSW is employed in the same building where Gen. Baird's office is located and can handle this work promptly. I have received several letters from hams away from N. Dak. and they sure appreciate the *QST* news. Drop me a card with news of yourself and other hams. Thanks. — *John*, W9YVF.

SOUTH DAKOTA — SCM, P. H. Schultz, W9QVY — DKJ, QVT and IK are teaching in radio school at Aberdeen. Have quite a number of hams in classes there. There have been several advanced to Radar or at least advanced school at Rolla, Mo. OXC, CJS, DB, DIY and yours truly had an unofficial hamfest at Sioux Falls one evening. Most of the men were busy or it would have been larger. Good to meet the gang and hope to see more in the western part of State next week. 73.

NORTHERN MINNESOTA — SCM, Armond D. Brattland, W9FUZ — A few reports and letters from some of the gang before leaving the north for the warmer clime of Glenwood, where I can be reached with mail and reports. Now working with RVH and OOK at the school here. AVT left the radio instructing field for the HQ Communications Company at Camp Barkeley, Texas, where he is a sergeant. BMX reports training program of St. Paul Radio Club being received enthusiastically by 85 enrolled students. Classes are now being conducted at one location in the Pioneer Building, which is furnished free to the club with the exception of the electricity used. Beginner's classes start on Monday with the present ranks totalling 42. When they have reached 6 w.p.m. they move to the Tuesday class and this is repeated from one week day to another until they finish their code training with the Friday classes at a speed of approximately 20 w.p.m. Saturday and Sunday evenings are reserved to enlistees in the armed services. In addition to the code classes there is one theory class which started September 30th with EKX as instructor, and another theory class will open up October 27th with MTH as instructor, with a third class starting November 9th with Harold Albrecht acting as instructor. With every day in the week given over to instruction it appears the gang at St. Paul are surely doing their part for the cause. TEF, RM2c in U. S. Coast Guard stationed at Memphis, Tenn., is back at Red Lake Falls on a 10-day leave. 73. — *Army*.

DELTA DIVISION

ARKANSAS — SCM, Ed. Beck, W5GED — We find ourselves on the eve of another fall and winter season which to all self-respecting hams means the time for increased activity of all kinds. The old attic is not unbearably hot these days and the indoors becomes more and more appealing, so be sure and get all the dope in, fellows. EIJ is with the Signal Corps at Ft. Monmouth. GNV made a trip through Little Rock, just before embarking for Panama where, at present, he is reported recovering from a broken and lacerated finger. HNK is with the Air Corps since making a brief visit to Little Rock. INO is back at school at John Brown after putting the summer vacation in on the West Coast. GWA appeared in L.R. for the examination in September. The whole gang offer their sincere condolences to FPU at the recent loss of his father-in-law. HBJ put in several days work in Little Rock recently while "vacationing." IUE enjoyed several days furlough at home recently. IRY is working at the ordnance plant and is setting the pace for the others in his line of work. HGE, since working recently in Little Rock, is now reported as missing in action. WK was last heard of when working for Uncle as code instructor in San Antonio. ICN accepted a position in the aircraft service and is now pursuing his duties in the 9th call area. ITW is real live wire up Searcy way and is in line for EC in the near future. IGM announces the recent arrival of a new jr. op., code speed as yet unannounced. PX finally did break away on his well-deserved vacation. More reports next month mean more news. 73. — *Ed.*, W5GED.

LOUISIANA — SCM, W. J. Wilkinson, Jr., W5DWW — FWO's address is USS *Henry T. Allen*, c/o P. M., New York. He is RM2c USNR. CRV is now in defense work in Boston. HSH is still stationed in Calif. BPL is on active duty "somewhere in Britain." FCG is an instructor for Philco in Philadelphia. If all of you will send dope on yourselves and one other ham we can give plenty of news each month. Let's try it. 73.

TENNESSEE — SCM, M. G. Hooper, W4DDJ — An interesting article that appeared recently in the *Memphis Press-Scimitar* revealed that there are nearly 50 former Memphis hams, mostly members of the Mid-South Amateur Radio Assn., now serving Uncle Sam either as radio operators with the armed forces or as instructors in training schools. A list of the calls mentioned follows: GLL, GKN, SW, LI, DOF, FTC, BYN, GMW, GUL, HGU, GIX, OL, GGH, DKK, DEP, FW, CRP, FLD, GIS, EVK, GCB, ATQ, HBP, BCA, ADT, IGX, VT, GBF, HFR. Your SCM has received no reports for some time. Let me know what you are doing.

HUDSON DIVISION

EASTERN NEW YORK — SCM, R. E. Haight, W2LU — Amateur activities have been quiet last month with many of the boys leaving for duty with Uncle Sam. It is hoped they will not forget their Section and report now and then some news items. Your SCM, LU, has just been reelected to that office for another 2 years and will endeavor to do a good job and hopes the boys will coöperate with him to keep the Section intact during this period when activities are restricted. ENY welcomes H. E. Schwartze as a new member of our Emergency Corps. Valley Radio Club of Spring Valley reports numbers diminishing. JBZ goes to the Navy and his brother, IYE, was inducted last month. Code and theory classes are still going as usual. EC contacts made with coördinator of civilian defense and hope to have something going about WERS soon. BSH has been reported as signing up with the Army as first lt.

MIDWEST DIVISION

IOWA — SCM, Arthur E. Rydberg, W9AED — SEE and PGG are helping Coördinator QAQ with WERS work in Council Bluffs. PGG is teaching radio for NYA WERS group in Des Moines, still busy building transmitters. CCY says the Army raise in pay sure helps. UOK is now junior communications operator at Fort Brady. VKZ is giving up EC, going to Signal Corps. Ex-JHM is on hospital staff at Fort Dix. AEP is busy building oscillator for code instruction. AHP took commercial exam recently. 5JSF is now at air base in Sioux City. ZDS is in Army Radar. BBB writes and says Army radio is FB. OJD is taking Signal Corps radio course exams. 73 — *Art*.

KANSAS — SCM, Alvin B. Unruh, W9AWP — It is with great sorrow that we report this month the passing of Quentin D. Moon, 26, W9AAQ, who was killed in the crash of a transport plane near Botwood, Newfoundland. AAQ was radio officer, and was one of ten killed in the crash. Until recently he was with Continental Airlines. He was a graduate of Wichita High School East and attended Wichita University. Sympathy is extended to his bereaved wife, relatives and many friends. IYF reports most hams in N. E. Kansas have left to aid the war effort. IDM is in N. J. studying airplane detection work. KCH is with FCC in K.C. KKR went to New Mexico as RR inspector. FRK is with Telephone Co. at Horton. IWS still lacks two states for WAS. ESL is instructor of math and radio at KU for Signal Corps in connection with Wright Field, Ohio. He now holds radiotelephone first. BQW gave his seeing-eye dog, Rex, to the Army. Rex was known to scores of Kansas hams. KTG is with the Navy at new Hutchinson base. WAH is sergeant-instructor at Army radio school in Kansas City. The following are also instructors there: W7's FMV, CCM, W8's VUN, JIN, W9's HMP, VUA. KNW was home on leave after six months sea duty as radioman. KNY is captain in Army; spent furlough at home after year as instructor at Ft. Benning, Ga. FRC is now colonel attached to White House Communications Staff, in Washington, D. C. Ex-9UQX, formerly president of W.A.R.C., is now a major with Headquarters, Army Ground Forces and assigned to the general staff, Washington, D. C. He is member of bar associations of Kansas and Oklahoma. VBQ purchased new home, reports that he contributed many pounds of scrap metals as result of moving. KCS is RM3c at U. S. Navy Air Station in Corpus Christi, Texas; says it is just like QKS and KN nets, only more so! He reports passing newsstand, "Saw *QST;* purchased same." MAE, EC for Wyandotte County, reports WERS equipment hard to get; now has Class A license. He reports DMZ has new junior op — a YL. FRI is instructor at school for Signal Corps in KC. NNU is on coast with Signal Corps. AHL is air raid warden. OSJ and ODU joined Navy. Following lined up for WERS in Kansas City, Kansas: MAE, JRV, DEL, RXB, RGA, DLR, EYF, AHL, SKO and SPN, with others to be added

later. MUC is in Washington, D. C. LFB is Wichita radio aide; has been active in organizing WERS activities. ABJ has been appointed to head committee on equipment. UCQ passed commercial exams and accepted new job. WBC took a bride. ICV is chief op at KGPZ. FET is chief op at KFBI. Ex-TBR returned to Wichita and joined staff of KANS. BCY returned from West Coast and accepted position with Boeing. TYV is control-tower operator; is taking additional schooling in Texas. 73. — *Abie.*

MISSOURI — Acting SCM, Letha Allendorf, W9OUD — AEJ is taking Electrical Engineering at MU, preparing to apply some very high voltage on certain persons when his number comes up in the new selective service group. WIS went to Cape Girardeau to take some Civil Aeronautics exams and ran into a code practice set, so combined business with pleasure. VDG says the WERS unit at Sikeston is shaping up well. JUR is a civil engineer at an ordnance plant in the W4 district. YZO is a carpenter at a defense plant near St. Louis. WAP is now a civil engineer at an ordnance plant near Kansas City. He took 2nd class telegraph exam, but had the tough luck to qualify for the permit only, and intends to take the exam again with marine operating in view. OUD is digging in for the winter and preparing for a visit from sister, ex-SRH, who has been doing things with charts and statistics at an airplane plant up Ohio way. And that, boys and girls, seems to be the whole crop of gossip. It was swell as long as it lasted. How about a few more letters next time? Send 'em collect if you haven't a stamp. The other fellows enjoy reading about you as much as you do about them. Lots of luck. 73.

NEBRASKA — Acting SCM, Lt. Comdr. P. H. Quinby, W9DXY — Thanks to the gang for their splendid coöperation and reports, Nebraska is back on the beam. UEV, newly appointed EC for Omaha area, reports Omaha gang organized with the CD set-up. KQX at Potter getting western Nebraska AEC organized. GFI reports on the Norfolk gang. QWU and QWW at technical school, Chicago. IZR teaching at Bismarck, N. D. YDZ in experimental station, Washington, D. C. HQS taking training in New Jersey. ZPW and CIR are at WJAG. QQJ is in San Francisco. QFT is wiring planes in Los Angeles. FMW, OVH and GNN were home recently on short visits. GFI, YRM, VQO and JBK are keeping the home fires burning. ONL transferred by AT & T to Washington, D. C. ITM is in Alaska. FZY is missing in Pacific action.

NEW ENGLAND DIVISION

CONNECTICUT — SCM, Edmund R. Fraser, W1KQY — CNF has been appointed Emergency Coördinator for Winsted. NEK is now district radio aide for the New London Warning District. The call letters WJQA have been assigned the Stamford DWC Operator's licenses have not been received to date. EER, district radio aide, was complimented by FCC for excellent work in preparing application. Norwalk hams have been sworn in as auxiliary policemen to give some means of identification for getting around during blackouts. They have been issued badges, and cars carrying mobile units will be equipped with red police lights. Frequency of meetings at CBA have been reduced to first and third Thursdays on account of gasoline shortage. HYF is getting married and moving from Norwalk. BRA has left Norwalk for the Sunny South, where he will teach code to Air Corp students under Civil Service. ATH reports code classes at GB progressing very nicely. One class has enrollment of 12 male and 5 female students under direction of IGT; another has 12 female students conducted by AGT, and third has 6 female students conducted by KQY. Each student is given a copy of ARRL's latest "Learning the Code." The following officers were elected at the annual GB meeting: KCO, pres.; TD, vice-pres.; ATH, secy.; JQK, treas.; directors: LTZ, AGT and BYW. Refreshments were served at the conclusion of the meeting. AGT, CUQ and TD are attending a course in touch typing at the West Haven High School. Master Sgt. DDP, former treasurer of NHARA, is home on furlough. NEK reports work in connection with the WERS application for New London Warning District license progressing very rapidly. EAO, state radio aide, reports KDK, district radio aide for Hartford Warning District, has application nearly completed for WERS license. Your SCM, reporting for the New Haven Warning District, has completed and forwarded application for WERS license to FCC. Excellent coöperation has been received from radio aides in the seven towns participating. Radio aide and EC JQK of Hamden has class of 112 candidates for restricted radiotelephone license. Radio aide and EC AGT of West Haven has 60 candidates lined up for examination scheduled to be held in about a week. Radio aides BHM, New Haven, LTZ, East Haven, BW, Branford, IJ, Madison and KAT, Guilford are lining up candidates for restricted permits. MSB, Hamden, has drawn up plans for a standard cabinet to house transmitters; upper door will drop down when opened and act as an operating desk. Each operator will be furnished a key to cabinet with master keys for associate and district radio aides. Several of these cabinets have already been completed and are being installed at transmitter locations. KKS sends 73 from Nevada, says plenty space for rhombics but can't use them. Ran across "Calling CQ" in a local library there. JQD is gauging and inspecting in a local defense plant.

EASTERN MASSACHUSETTS — SCM, Frank L. Baker, Jr., W1ALP — LAD has taken over as EC for Brookline. MCR is new EC for Dorchester, Section 1. KSA is now in the Coast Guard. MPT got his commercial ticket from studying at Gallups Island and is now on the high seas. COX is teaching radio at Newton Trade School. NEZ is working in Washington, D. C. BVL bought a new house. LYG home for awhile. IZT is now a warrant officer. NJV is in the army. LBY is going to school in Phila. KQJ is going to school in Maryland. SH, FSK and MLL are in Maine. FL is a lt. colonel and is up in Maine. NIA and his brother are going to school in Maine. Some more hams in the Signal Corps as civilians at Boston: BLI, EFJ, MDS, MSO, BVC, BGU, MMK, NAX, CAW, KTX, MWF, JYA, LXT, OR, LHK, FSP, HQY, LDG, LPW, PB, GGM, INB, CKY, FJK, MSV, MVF, EAX, SL, IOR, AUN, LAR, JEU, KYI and LNX; enough to start a radio club. To other hams who are working in this Section, why not drop us a line and let us know who you are? Your SCM receives letters from hams everywhere who take great interest in what the rest of the hams are doing and where they are. Even though you may be from other districts, each copy of *QST* includes all the sections in this Country now. LEA is in Calif. NFN is in the Signal Corps. LGY is in Fla. KBP is in N. J. EAS is in the Navy. ILD is in Ohio. JNU, IQH, JDU, HXE and LLA are working in Boston. JED and NON are in Lynn. MWG is in Washington. ACM is doing a nice job for CDC along with CRW, KNU, MUB, CBY and NON. MDV is working for Raytheon. AHP is doing a nice job in Fall River, has classes going for 3rd class permits for WERS. The city bought a lot of equipment. KPE, KLO and CIA are working in Washington, D. C.

WESTERN MASSACHUSETTS — SCM, William J. Barrett, W1JAH — Big news this month is the granting of WERS license to the Region 1B Warning District. License is issued in name of the City of North Adams, site of the District Warning Center, with JAH as radio aide. Call letters are WJPG. Resident exams are now being held for 3rd class radiotelephone permits for CD radio classes which have been conducted in Adams and North Adams. Instructors in these classes have been FZI and MJD in North Adams and NAQ, JAD and JAH in Adams. Personal news from the Section has been scarce, but here is some: IJL is now 2nd lt. in Signal Corps; ICW is operating at WAR; MKR is now tech. sgt. in Signal Corps "somewhere in New Guinea"; KZS is home after receiving medical discharge from Army; NDN is with Navy Radar unit. Pittsfield Radio Club is going to run a second ham course after the completion of the present CD school. News reports from most of the Section have been conspicuous by their absence. How about some gossip, gang? BVR is chief instructor at Signal Corps school recently established at Westfield State Teachers College.

NEW HAMPSHIRE — SCM, Mrs. Dorothy W. Evans, W1FTJ — IFN is now in the Merchant Marine. HOV has joined the Army. FGC tells us that he now has a commission of lieut. (jg) in the USNR, having given up his teaching position temporarily. JEH has received a discharge from the sanitarium at Glencliff and is now hot on the trail of a job. Before the next issue of *QST* goes to press, we expect that JMY and MUW will be answering to "Mr. and Mrs. Joe Moskey." It has been reported that HXJ is missing at sea. "Johnny," as his associates knew him, was widely known in the State, and his many friends still cling to the hope that his ship may yet return. HFO is still working for Harvey-Wells. We understand that CME was a recent visitor in his home state. Why not give us a shout next time, Stu? Your SCM would be very pleased to hear from you boys in the service. Your friends like to know as much about you as possible, so why not do it through your own column in *QST*?

RHODE ISLAND — SCM, Clayton C. Gordon, W1HRC

"Designed for Application"

THE 90505 SECONDARY FREQUENCY STANDARD

A Precision Frequency Standard for both Laboratory and production uses. Designed around the GE G-18 and G-18A crystal, having a frequency temperature coefficient of less than 1 cycle/Mc/C°. The crystal is sealed in Helium in a standard metal tube envelope. Adjustable output provided at intervals of 10, 25, 100, and 1000 KC with magnitude useful to 50 MC. Harmonic amplifier with tuned plate circuit and panel range switch. 800 cycle modulator, with panel control switch. Panel plate supply control switch. In addition to Oscillators, Multi-vibrators, Modulators, and Amplifiers, a built-in Detector with 'phone jack and gain control on the panel is incorporated. Easily adjusted to WWV. Self-contained AC power supply with VR 150-30 voltage regulator. Used in quantity by Signal Corps. Navy, FCC, British and all large government prime contractors such as GE, RCA, Western Electric, Sperry, Westinghouse, etc. Cabinet size 9" x 9⅝" x 10½", weight 20 lbs. Compact, dependable, stable, trouble-free. Price complete with GE crystal and tubes $135 net, f.o.b., Malden for 115 V. 60 cycle model. Available for the duration, of course, only with proper priority.

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MAIN OFFICE AND FACTORY

MALDEN, MASSACHUSETTS, U.S.A.

— LYE, who served the P.R.A. for so long and so well as its most recent secretary, was given a dinner and pen and pencil set gift recently at the "Old Canteen" prior to being inducted into the Army Air Corps. George had previously tried to enlist in the Air Corps but was not acceptable, but strange as it seems, upon being drafted, was placed in the service he tried to enlist in. The gang turned out in fine style for his going-away party, some 23 being present. Your SCM tried his hand at being "Roast-Master" with doubtful success, but George has promised to keep in touch, and you should be hearing more of him as time goes on, through this column. A very fine letter from MTA (ex-K5AM) arrived from Fort Adams in which he tells of being appointed a warrant officer and is the communication officer there. He writes that NCX is now with the American Air Lines as operator. Another of our R. I. boys that was with him, HEN, has been with Pan American Airlines for the past year after being discharged as a staff sgt. at Fort Adams. MTA also ran into W1JFF the other day, who told him that MMX is hopping off for a trick in the Army any day now. MTA's address is W/O Donald R. Johnson, Radio Station, Fort Adams, R. I., in case you boys want to drop him a line now and then. MOK writes from Philadelphia that he is at the RCA Signal Corps School and that the teachers are the best in their line and get the stuff across in great style. He will be there for several more weeks and his address is The Gladstone Hotel, 11th at Pine St., Apt. 52, Philadelphia, Pa. From Norm Gertz at the Message Center, War Department, Washington, comes word that he is expecting to come home soon to enlist in some branch of the service if he is not given a rating where he now is a civilian employee before he gets a chance to get home. He hears from KOG quite often. He also hears from LCH every so often. Joe is staff sgt. at Indio, Calif., at present. LWA called on Norm the other day. He has lost track of KCS and has had mail returned. Norm also tried to contact LDL, but couldn't find anybody at Monmouth that knew him. Norm's address is 1762 Lanier Place, N. W., Washington, D. C., until he changes it for a camp somewhere. We heard that BFV was home in Providence on leave, recently. Understand he is stationed in Washington. Guess that about winds up the "Jerky Journal" for another month, but you boys can see what can be done when you hitch up your pencil to a sheet of paper and send me the "makins."

VERMONT — SCM, Clifton G. Parker, W1KJG — FRT reports excellent results in code courses at Montpelier and recently visited in Burlington to confer on WERS set-up. NPM is at U.V.M. engaged in courses for his master's degree in Agriculture and has joined the Burlington Amateur Radio Club. KWB has terminated his work at WCAX and gone to Portsmouth, N. H., where he has position as chief engineer at WHEB. HPN has resigned his position at WSYB and taken KWB's place at WCAX. MJU, NUZ, LZQ and 2JUB have returned to U.V.M. for the school year. MLJ is busy as instructor at the NYA school. NDB is acting as instructor at a welding school being conducted in St. Johnsbury. Lt. Harry Moore, 8VVZ, was in Burlington recently on furlough and renewing acquaintances. Recent visitors at your SCM's were AEA, IDM, JRU and IQG. MCQ has returned home from the Veterans' Hospital and is hopefully awaiting the "go ahead" signal on the air. Examinations for WERS licensees can be had before NLO at Burlington. JRU and family recently visited friends in Vermont. AEA reports interesting developments in his service with the Signal Corps. Code classes how being carried on in this Section are at Burlington, Montpelier and Morrisville. Any person interested can secure details by communicating with William Medler, W1FRT, Montpelier, Burtis Dean, W1NLO, Burlington or your SCM at Morrisville.

NORTHWESTERN DIVISION

IDAHO — SCM, Don Oberbillig, W7AVP — FDH sends a nice report from Idaho Falls. BNJ is a dispatcher for railroad at Fort Hall. IHE is operating farm. CEI has been stationed at Gowen Field for short time. IMC with the Navy and HTY is EC for Idaho Falls. FIJ enjoys new job as airport control tower operator. HOV would like to join Army. HPH joined Civil Air Patrol. ABK, AQK and ex-ALC on instruction staff of Signal Corps School, Boise. FOF likes to trouble-shoot on Army transmitters. GU is day foreman at Gowen Field Sub-Depot. BDX in Northern Idaho. CUG getting ready for another Stibnite winter. BCU contemplates Army service. How about more reports from Idaho? With so many fellows in service, let us know what those hams who are left are doing.

MONTANA — SCM, Rex Roberts, W7CPY — Electric City Radio Club busy and active as usual, having established a class of 28 for instruction for radiotelephone third class to train operators for WERS. Work is continuing with the municipality for the WERS setup. CUK called on the Glendive hams on the way home on furlough from Fort Monmouth. AFY called on the Great Falls gang; CC has left for Navy Radar; HEM and BXL want to get into Radar branch of the services; BOZ is in Spokane; CNP is instructor in Signal Corps School in Kentucky.

OREGON — SCM, Carl Austin, W7GNJ — EC, JN. DXF and family called on the HHH-GNJ shack and spent an evening discussing past and future ham activity. Then HJI and XYL Beth dropped in for a chat; and last but not least, GTW and XYL Faye spent an evening practicing code and looking over the rigs. GTW just back from far north on 10-day furlough, then back to even farther north for a year. HKI has his receiver going again and spends some time each evening doing useful listening. ITG reports that O.I.T. is all Army radio now except for code classes at night, with many YLs attending. HVX, secy. of CORK, reports 26 members in current code and theory classes; two more members made the 199 mile trip to take Class B exam, but each missed one character, so no license; two members went into Radar last month, and another so far this month, the latter being Earl Dawson, who was accepted seven days after examination. With Oregon hams scattered all over the world it is difficult to gather news, so how about a little dope from some of you hams? 73.

PACIFIC DIVISION

EAST BAY — SCM, Horace R. Greer, W6TI — EC, QDE. EC u.h.f., FKQ. Asst. EC u.h.f., OJU. OO u.h.f., ZM. Wednesday evening, October 21st, at the Hotel Leamington found the following present at the East Bay Section Meeting of the ARRL: EY, QAZ, THO, FKQ, NRM, ZM, HS, KZN, KTI, SFT, ex-AYZ, UT, TI, JEE, F. Arnberger, Mr. and Mrs. F. Keller and Mr. and Mrs. J. H. Greer. Some swell Navy movies with plenty of action and other war pictures were shown by our old friend HS. These meetings are open to everyone the third Wednesday of each month. Coming gas rationing, dim-out, in the service, in defense jobs, and a thousand other things it seems have cut down the attendance so much, this meeting was the smallest by 60% we have ever had, and it looks now that we might have to call off the meetings for the duration. It was decided to finish the rest of the year with the hopes that the few that are still free will turn out, so it will be up to everyone to do his part if we are to continue these gatherings. HS is moving to Los Angeles. IMA and ZF are in Army. LJC is in Merchant Marine. Have you joined up with WERS yet? Better get in touch with EE. Everyone now in Alameda County has been requested to join up with Oakland WERS. The license is due any day now, as it was applied for in September. Don't forget to send in the news. 73. — "TI."

ROANOKE DIVISION

WEST VIRGINIA — SCM, Kenneth M. Zinn, W8JRL — Mountaineer Amateur Radio Association elected officers for the coming year as follows: president, GBF; secretary, Mr. Charles Handy; treasurer, MIP. The club is still very much together and getting along fine. BOK is back on the job after a month's stay in a Richmond, Va., hospital. Our sympathy to KKG, whose father recently passed away. OXO was a recent visitor in Clarksburg. CVX has finally been heard from and is located in Schenectady, N. Y. KGT is now located in Chicago, Ill. KWI had a furlough from the Navy recently, and visited his parents and friends in Clarksburg. QJS is now working in Baltimore, Md. RCU is now located in Hawaii, doing special work with the Army. KWL and SPY are having very good success with wired wireless. JKN has enlisted in the Army as an instructor, with a second lieutenant rating. Your SCM has sold his transmitter and receiver to the Army Signal Corps; and by the way, fellows, if you have any commercially built equipment and would like to sell it, please contact the Signal Corps in Columbus, Ohio. They will get in touch with you immediately. Please send in your news, fellows, it's hard to write a column without it. 73. — *Ken.*

ROCKY MOUNTAIN DIVISION

COLORADO — SCM, Stephen L. Fitzpatrick, W9CNL — EII is now located in Denver, Colo., where he flies with Continental. YKP is under Civil Service (radio) in N. J. YFJ visited Denver on his vacation. HCG is now an airways operator. QCX is building a vacuum tube voltmeter

and also other testing equipment. Mel Rogers is a new ham (LSPH). SVL visits his home on vacation from G.E. Co. HXZ has developed code speed doing code instruction work at Naval Training School in Boulder. TLM has just changed jobs, he is now chief auditor, Vocational Defense Training. Les says they need radio instructors at good wages. Amateurs who really know radio will have no trouble making the grade. HGK is a 2nd class radio technician with the Navy, located at Treasure Island. HLJ came to Denver on a visit. JKC has been transferred to a new location. BQO is moving to new QTH, if he can find one. CAA keeps his code up by operating morse as a vacation relief opr. NDM is flight instructor at Boulder. FKK is in the Air Corps. MGA is located in Barksdale, La. CYM is RM3c in Fla. SWM received his commercial ticket and is operating BC station KVOR in Colorado Springs. JVR is welding for defense. MMI still in Steamboat Springs taking radio course. FBF has an appointment in Civil Service. NWQ visits home from Las Vegas. EHC reports himself at Philadelphia, teaching others to be hams. KHQ reports that YCD has gone to San Antonio. GMB and GKW are on the Pacific. GMB is in Palisade. DVM doing RR telephone maintenance work. MGX very busy on railroad work at present. KSE, ESP and NVU instructing at school in Trinidad. KSE and ESP have the graveyard shift. ZXL enlisted with the Marines. NSY is keeping radios in repair at Huggins Electric Co. NVU is constructing a 2½ transmitter. HIR, BTO, FQK, FYY, HXZ, UXI and FFU busy with teaching radio at Boulder. Thanks fellows for your swell reports and letters. 73.

SOUTHEASTERN DIVISION

EASTERN FLORIDA — Acting SCM, Frank C. Fassett, W4BYR — Yours truly has been asked to function temporarily in this department pending the election of somebody better fitted for the job. Feed me the stuff, you who have been wanting to see this Section back in the old accustomed spot. FZR is with CAP at Sarasota. FYI is with Navy on Treasure Island. DES is with Philco. TZ is with Army at Fort Monmouth. DEN is with Army at MacDill Field. The HAD father and son combination is busted. Dewey Jr. has returned to GMI in Atlanta, while Ole Country Cousin has gone to Alaska with Army. PT is heard nightly signing the graveyard shift from WDAE. Sarasota gang misses IE, who has returned to Headquarters as Asst. Secy. AFU's help joined Navy, so he prints Post alone now. CLW was in Tampa recently. CXL is studying underwater sound at Miami. HGO has been appointed radio aide for Sanford and Seminole City. ELZ is flying for the Army. Many thanks to Director Bill Shelton and EYI, EC for Pinellas City, both of whom contributed to this. The former is now working in Eng. Dept. of Bell Tel. in Atlanta. Says hello to Florida gang and reports he saw QP in Army SC at Fort Mc. recently. AHK is at Powder Springs, Ga., with FCC, but has application in with Navy. Spence says ANH has taken aircraft job in Calif. FRE and IGQ have built a sailboat and spend spare time on Tampa Bay. HPM has new job with St. Pete police department keeping them on air. EWS has operating job. FPC is now chief with Coast Guard. DBA has left police department and is with Motorola as sales representative. EPW is now chief at WSUN, getting on air to announce station, which is more than the rest of us can do. FHX and FZW are first class radiomen in Navy. Spence asks you fellows to help by sending your dope to him by the 15th of each month, please. The Tampa gang have responded 100% in the loan of u.h.f. gear for WERS in Hillsboro City. Seminole, Pinellas and Hillsboro Counties have all filed with FCC for WERS. Will everybody please send me news of interest pertaining to this Section by the 15th of each month? I'll see that Hartford gets it. Address P. O. Box 9298, Sulphur Springs Station, Tampa, Fla.

WESTERN FLORIDA — SCM, Oscar Cederstrom, W4AXP — MS received a QSL this week from the last QSO he had before the shutdown, with 9ZWQ. ECT-FJR, Lola and Rich are back in the Section once more after a long absence. He will be with the gang out at the radio section of the A & R at the Naval Air Station. HJA and AXP visited ECT and FJT at their temporary home at Candler Court. FRQ of Corpus Christi, Texas, reports the arrival of bouncing YL Jr. op at his home. He is an aircraft electrician, has a new call, 5KSS. GAM is working at Naval Research Lab in Washington. PE has moved to 1507 Hernandez Street, Pensacola. FJM is planning on joining either Army or Civilian Radio School. ICU is in civilian radio school and doing fine. GQF is working at Tyndall Field, Panama City. GRI sold her transmitter. FJM sold his HQ120. EGO works at Tyndall Field. He and the Missus are looking for the stork. BJF and GTJ are holding down the radio end of the Fla. Defense Force. FOX is working at the shipyard. GZB is working at Tyndall Field in radio. BCZ is in Tally. Credit for Panama City report goes to GTJ. Tnx, OM. DAO is having a barrel of fun with his recorder. Ex-6MYV is away on a special training course. HJA sold his receiver. CRU is doing fine at the radio shop in the A & R. CQF is chief electrician in departments at N.A.S. 73 from AXP.

SOUTHWESTERN DIVISION

LOS ANGELES — SCM, H. F. Wood, W6QVV — Hi, gang. In passing through the High Sierra country I learned that PZU is in service somewhere on the East Coast and that CUY had just gone into the Navy. Heard also that MFJ had finished his course at Radar in the West and was now stationed on some beautiful islands in the Pacific. Several others have just gone into the various schools, and all that I've heard from are most enthusiastic. BUK writes that during the present drive for junk and heeding *QST*'s suggestion on scrap copper he found he could produce six pounds of copper, forty-five pounds of cast iron and forty feet of leaded cable. I wonder how many of us even took the trouble to make a search. Also found a letter from the Inglewood Amateur Radio Club and learn that they have recently elected new officers for the forthcoming year, and ZCN is prexie, QIR the v.p., RNN handling the secy's job while RNS handles the cash. This club is certainly up and going good. They have planned for moving pictures and technical talks as well as other entertainment during the next few months aside from their very active work and interest in the WERS work. Meeting the first and third Fridays. I'll be a seein' of you. Local WERS program is being slowly but surely worked out. We still need more operators — those who would be available in case. Let us hear from you soon so that we can take active participation in the OCD drills which are very interesting and are working very smoothly. By the time you read this, if you haven't already received an application form, and want to do your part, just get in touch with me and I'll see that you get 'em. That's all for now. Please help me keep this worth sending in by letting me have some interesting news. 73 es CUL. — *Ted.*

ARIZONA — SCM, Douglas Aitken, W6RWW — The Tucson Short Wave Assn. reports holding two meetings a month, with a fine turnout at every meeting. The code classes being conducted have around 100 students. A fine record is being nailed up by the Tucson gang. TXM is radio technician at an air base. TOZ has left the state for Calif. BFA is teaching code for CPT courses. MLL continuing all of his code and theory teaching and turning out new hams. IYZ dropped in on the Nogales bunch for some ragchewing. Won't you drop a card once in a while telling of your activities and any of the gang you know about? 73. — *Doug.*

SAN DIEGO — SCM, Richard Shanks, W6BZE — Just got the news that MKW, who is now located in Alaska, has been married, and has changed his call to K7JBB. SIQ is attending University of Calif., studying engineering. AXN is holding down a govt. defense project in Imperial Valley. QUS is working for Telephone Co. in El Centro. KNL and NLY are both in the Navy. DAZ is now RM1c in Navy at Corpus Christi, Tex. OHO is also RM1c in Navy. CIW is a lieut. located in San Diego. HWJ has a box full of commercial tickets and is on the tech. staff at KXO, and is also instructing radio at the Junior College in El Centro. KW was in San Diego for a short visit and is taking a new position with Raytheon. That is about all the news at present, thanks to HWJ. Good luck and best of 73.

WEST GULF DIVISION

NEW MEXICO — SCM, J. G. Hancock, W5HJF — JWA has just been accepted as RM3c in the Navy. Jack had to wait ten months to be 17. David Erwin completed his Radar training at the Treasure Island station with straight As, and has been assigned to the San Diego Radio School as an Instructor with RT1c rating. BKD, who had his ship shot out from under him while serving in the Merchant Marine last spring, which left him on the big pond several days before rescue, is back with CAA at Tucumcari. DER is now civilian instructor at Camp Crowder. KCW has been having a swell time walking out a bad connection on the toll line of M.S.T. & T. in an all-night downpour. Clovis broadcast KICA is badly in need of an engineer, Class A amateur license sufficient, living quarters at the transmitter but no cooking facilities. Anyone interested write Lee Biggs, Manager, Radio KICA, Clovis, N. M. We need more reports, gang; keep them coming in each month. 73.

(*Continued from page 92*)

hum pickup and well shielded. Shielded "bath-tub"-type coupling condensers are desirable in low-gain resistance-coupled stages, and plate leads should be shielded as well as grid leads.

Degeneration is very helpful, not only in lessening hum but also in improving frequency response and reducing distortion. It can be applied most easily in low-level stages by simply omitting the cathode by-pass condensers; while the gain is reduced thereby the overall improvement more than compensates for the loss.

Good power supply regulation, filtration and decoupling are even more essential than in most audio amplifiers, particularly if the motor is connected to the same a.c. line and line regulation is poor. Plenty of capacity is desirable throughout, especially in the output filter condenser.

All metal parts in the system — turntable, motor frame, etc. — should be grounded, as well as the amplifier chassis. If the turntable is not grounded through its drive system (don't rely on a grease-packed thrust bearing), grounding brushes may be mounted to bear on the under side of the turntable or tinsel wrapped around a non-lubricated part of the drive shaft. Observing the amplifier hum level, first with the motor running and then without, will disclose if it is contributing hum. Reversing the a.c. input leads to the motor will often show that one manner of connection gives the lowest hum level.

Cryptanalysis Lesson

(*Continued from page 50*)

two letters in the same row appears at the right end, we substitute the letter at the left of the row; as, **qu** becomes **RQ.**"

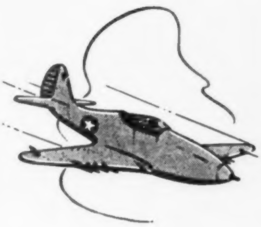
"Right, Mr. Socrates. Now, this cipher chart can be rearranged at will, just like any alphabet, and each new chart will produce vastly different cipher equivalents for the same plain text. A good method is to use an alphabet derived from a keyword. We might use the key **Liberty Ship** by beginning it in the second line and completing the alphabet, so we'd have a square like this," and Ed printed rapidly:

u v w x z
l ij b e r
t y s h p
a c d f g
k m n o q

"The excellent feature about this cipher is that it often breaks up common digraphs. With a plain text fragment **comes home** the encipherer would divide it into two-letter groups as **co me sh om ex.** Notice that the repeated digraph **om** will not be enciphered the same way on its second appearance since each letter falls with a different combination the first time."

"Swell! It looks like a peachy system. How do I solve it?"

(*Continued on page 108*)



(*Continued from page 106*)

"You *would* bring that up. It's quite a complicated method of analysis, Jimmy boy, and I suggest you get a text to study. A good one is *Elementary Cryptanalysis*, which contains analytical methods for all kinds of ciphers. You can get it from the American Photographic Publishing Company in Boston, and I think the price is $3.50. Also, since I expect soon to be Private Wilson, U.S.A., you might keep up your practice in cipher work by joining the American Cryptogram Association and receiving their monthly organ *The Cryptogram*. It costs a dollar a year, and the treasurer is E. E. Alden, 189 Montcalm Drive, Rochester, N. Y. Meanwhile, here's your last homework."

"Okay, Ed — and thanks! See you before you leave."

22	302	272	86
35	193	43	153
213	112	232	265
152	42	66	

NMNIJ TNIEA ESUEN SVNRS DAEIE BSUGD RNRYT PEBTF JHOEH YOEUI WRIHW RDSAI MIAIG MROIS ROEAD RNMDR ANHSS AHS.

IELWA LWPWL USFUA ETAEB OHRWA RALPT DTSPF HOEH EELRL NNESE CDETE SSWPO LDOO.

ZLTBJ PZXTI HEUVY OZPOP JTXAZ GTTST KXJPW AKPKP QIIXN VQQYE SHAQU QYODB OWBVU BNCTM DVESS LVWRZ NUJKU HJTHA YELLV.

ANJOS EEAUT MOHMS NODOO TARTU TICEL SSFNT AEYYO HMMAG TADAW OLNNN SDIMA.

BESKI VVEGU OKIIS XBEGZ JWAGB VNXCK ZITDE MMTSR KRIGV FSHLK OYEPS VXRTO LVZMZ YENXG WEDZN OLVAV AZSOS IQ.

— *The Cryptogram*

P.O.W.

M. R. McArthur, G4LB, and Lt. Dennis L. Flower, G8TO, are reported being held as prisoners of war.

Charles Woodin, KA1CW, whose name was erroneously listed in *Silent Keys* in the September issue, is now reported to be alive and well, but is being held a prisoner of war by the Japanese.

IF YOUR COPY OF *QST* IS LATE—

Bear with us and the nation's transportation systems. We are both doing our best — *QST* is being printed one to three days earlier each month to help keep deliveries up to schedule — but unavoidable wartime delays sometimes do occur. So if *QST* is late, just be patient — it's on the way.

A Course in Radio Fundamentals

(Continued from page 67)

Assignment 20:

Q. 10 — 72 per cent.
Q. 16 — 3898.4 kc., 3901.6 kc.
Q. 17 — 8400 cycles, or 8.4 kc.
Q. 18 — 28,645 and 28,655 kc.
Q. 23 — 150 watts.
Q. 24 — 13,333 ohms.
Q. 26 — 260 watts.
Q. 31 — 70,000 ohms; 16,130 ohms; 194 watts.

Assignment 21:

Q. 4 — Grid-bias modulation: 40 watts (efficiency 33⅓ per cent) to 53.4 watts (efficiency 40 per cent).

Plate modulation: (75 per cent efficiency) 240 watts, neglecting increased dissipation with modulation; 160 watts, continuous 100 per cent sine-wave modulation.

Q. 14 — Continuous sine-wave modulation: 176 watts; 4860 ohms. Neglecting increased dissipation with modulation: 196 watts; 3560 ohms.

Assignment 22:

Q. 4 — 112.5 watts; 1.2 to 1, primary to secondary.

Assignment 24:

Q. 8 — 57.28 Mc.; 16 kc.; 4.
Q. 11 — 7036.25 to 7038.75 kc.; 1250 cycles (1.25 kc.).

Errata

In the formula $R = \frac{97 \text{ volts}}{0.855 \text{ amp.}} = 1133$ ohms, page 57, July *QST*, the denominator should be 0.0855 amp., since the current is 85.5 milliamperes. In the same installment, Figs. 9 and 11, on pages 60 and 61, should be transposed.

In Installment 3, August *QST*, the decimal point should be shifted one place to the right in four of the answers given to Question 8, Assignment 6, making them read as follows:

	E_R	P.F.
Condenser shorted	0.636	6.36 per cent
Inductance shorted	0.628	6.28 " "

The answer to Q. 20, Assignment 12, was incorrectly given as 87 db. It should be 97 db.

Experimenter's Section

(Continued from page 48)

to have much better luck with a tone-modulated signal than with pure c.w. With the dummy secondary lines paralleling the primary lines, it seemed to make no difference what was connected to the secondary — the signal remained unaffected.

The receiver used was a 6-tube automobile radio revamped for low frequencies. The receiver was not connected to the line, since it operated from the field surrounding the line.

At this station, elementary carrier-current experiments have been carried on using rather crude equipment with good results. W5HXA and I designed and built a t.r.f. set that, so far as working is concerned, is "the nuts." It uses two stages of r.f. with 6SK7s 6SK7 regenerative detector, 6H6 volume limiter, 6J5 audio and 6F6 output. With this receiver and the transmitter, consisting of a 6L6 Hartley running 25 watts input and a 6C5-6L6 modulator, we have made an almost house-

(*Continued from page 110*)

to-house field-strength canvass for an airline distance of about a mile and a half. At every point we tested a readable signal was obtained, even through two power substations, although the signals were weaker.

Several factors have convinced us that some sort of m.o.p.a. is desirable, especially for 'phone work. The chief objects in using this type of transmitter are better frequency stability and higher possible modulation percentage.

In the article in March *QST* on carrier-current communication, you neglected to say where we were to get the high-capacity, high-voltage mica condensers. Since we couldn't locate any, I used some 600-volt micas. Now I know why 2500-volt ratings were specified for each of the condensers in series! Having used up enough to make me cautious, I switched to ganged b.c. receiver condensers and they work better.

At present, we are trying to develop low-power highly-portable transmitter-receiver combinations. The most simple arrangement with a promise of being satisfactory is a receiver with a single 6K7 r.f., 6Q7 detector, a.v.c. and first audio, and 25A7GT output and a transmitter using a 6J5 and 7F7. These small units are to be used for campus communication at S.M.U. A larger rig is also in process here. All receivers used so far use 175-kc. i.f. transformers for interstage coupling. — *David Geiser, W5IXM.*

Using a carrier-current converter and transmitter similar to that described in March *QST*, I am able to work approximately 4 miles via the power lines on 170 kc. with 30 to 60 watts input to a 6L6 with Q5, R6 to 9 reports, day or night. I would like to hear from anyone in this vicinity interested in carrier current. — *Dick Briemer, L.S.P.H., 523 Brown St., Rochester, N. Y.*

Francis L. Ambrose, K6UQH, ARM2C, Room 603, YMCA, San Diego, Calif., would like to contact anyone in the San Diego area interested in carrier-current communication.

W5KHH is building a c.c. rig and plans to work with WW5A and WW5B in Monroe, La.

—···—

W1ANM writes that the names of Tom Schlagel, W1KYN, and Paul Moore of Newburyport, Mass., were inadvertently omitted in the description of the AAD system of that city described in October *QST*.

—···—

W6EA recalls that he and W6EB were able to cover a distance of about one-quarter mile on voice, before the last war, with a system in which the transmitter consisted of a spark coil whose primary was connected in series with a battery and a microphone and whose secondary was connected with one terminal to a long insulated wire and the other to a water-pipe ground. The receiver consisted merely of headphones connected between another long insulated wire and a water-pipe ground. The vibrator of the spark coil was screwed up tight so that it would not vibrate.

U. S. A. Calling

(*Continued from page 31*)

General information:

Candidates for enlistment must be 18, but students under 18 may be included in college quotas provided they agree in writing to enlist when they become 18. . . . All candidates must pass a physical examination. . . . Students must be enrolled in an accredited college. . . . All colleges have quotas of students to be enlisted. . . . During the second year an examination will be given all enlisted students. Those failing to pass will be called to active duty as enlisted men. . . . All graduates in the ROTC advanced course will be commissioned upon graduation. All others enlisted in the ROTC will be sent to the nearest Reception Training Center and, upon successful completion of the normal course of training, will be sent to Officer Candidate School. . . . Enlistments in the various branches of the armed services will be accepted at the time when representatives of the Joint Procurement Board visit the various colleges. Such visits are usually made three times a year. . . . Enlisted students will be deferred from induction under the Selective Service Act until graduation, but they are subject to call to active duty at any time during their enlistment period.

How to Design a Swoose

(*Continued from page 27*)

No attempt is made to furnish a complete diagram of this "Swoose," and no two would ever be alike since the contents of junk boxes vary widely. The builder should decide what features to incorporate in the "junk-box special," canvass the material on hand, and start planning. It will be found advantageous to use a long, narrow chassis to allow plenty of room on the panel for the multiplicity of controls, and plan carefully to take best advantage of chassis and panel room.

An arrangement permitting isolation and shielding of conflicting circuits is necessary. As all input and output circuits come to the front panel, careful planning is required to avoid picking up hum from grid circuits close to and paralleling a.c. circuits. All filaments are on as long as the power switch is turned on. Plate and screen voltages for the audio section are turned on by the switch on the volume control. Separate switches are provided for the superhet and oscillator plates.

The "Swoose" will do 'most anything, and the end is not yet — we're going to add a "tuning eye" to the super (it's already in place but not yet wired), and voltage regulation to the oscillator and make it a really deluxe piece of junk!

Strays

1st Cannibal: "We've just captured an amateur radio operator."

2nd Cannibal: "Good! I was hoping for a ham sandwich." — *The (N.C.) Arc.*

A 25-Watt 2½-Meter M.O.P.A.

(Continued from page 43)

current at resonance to 60 ma. At this point, the bulb should light to more than normal brilliance, indicating an efficiency of better than 50 per cent. When loaded, the amplifier plate current should not fall below 10 to 12 ma.

In coupling the modulator to the plate circuit of the r.f. amplifier, the output-transformer taps are adjusted for about 5000 ohms primary and 6500 ohms secondary. The use of a screen resistor of 25,000 ohms and a cathode resistor of 750 ohms results in a static plate current of about 50 ma. to the 6L6.

The performance of this rig shows a vast improvement over the simple modulated oscillator. Frequency stability is all that one could ask for and frequency modulation is negligible.

Akron and the WERS

(Continued from page 16)

messages will be sent substantially simultaneously in order to expedite getting the information to the commanders. Prior experience during test periods last year has indicated the imperative need for expediting the messages requiring the sending of police and firemen to various parts of the city. Furthermore, the police and fire departments' radio system will be utilized in forwarding messages from Central Control.

During test transmission periods various messages such as "Report of Incident" and "Report of Services Dispatched" have been transmitted by radio in an effort to train the operators in the district control centers as to the speed with which such messages may be copied by the operator or his assistant at the central control. Additional training has been given at weekly club meetings.

At the Control Center

In our plan of operation, the police and fire commanders are stationed at the remote-control point of the Central control center and the auxiliary police and fire commanders are stationed at the Central control center room. The radio aide is stationed in the same room. Each of these commanders is equipped with a set of headphones whereby he receives messages as they come into the WERS station. Furthermore, the police and fire commanders have a microphone for their use in issuing orders over the WERS station, subject to the control of the assistant radio aide in charge of the remote-control point. An open telephone line permits communication directly between the police and fire commanders and the auxiliary police and fire commanders. In this manner these men receive all incoming messages either by radio or by the open telephone lines from each of the four district control centers. The radio aide in the central control room normally handles the sending of all the radio messages from the central

(Continued on page 118)

(Continued from page 116)

control station, and he is responsible for seeing that satisfactory operation is maintained constantly. It should be noted that the assistant radio aide at the remote control point maintains constant check of all transmissions and sees that the receiver is properly tuned.

All Akron control center transmitters and receivers operate on one frequency, which is different from the frequency utilized for the portable unit transmitters and receivers in the respective district controls. Consequently, messages may be readily received and transmitted between the control centers without interfering with the similar transmissions from the district controls with their portable units in the field. Furthermore, it is contemplated to equip central control with a transmitter operating on a third frequency for contact with the state police headquarters and a transmitter on a fourth frequency for contact with the local electrical public utility company. A fifth transmitter operating on still another frequency within the specified WERS band is projected for direct contact with various manufacturing establishments producing war materials in the Akron area. It is thus apparent that in the final radio set-up central control will be equipped with five transmitters and receivers operating on five separate channels, and this necessarily will require assignment of several additional operators at central control for communication work.

Test Blackout Results

On September 29, 1942, Col. J. L. Cochrun, Commander of the Summit County Civilian Defense Corps, called a test blackout during which the first active and coördinated use was made of the WERS system. It was during this blackout that use was first made of portable Abbott DK-3 units in aircraft patrolling the Akron area. The portable equipment and antenna systems were installed in the planes about one hour prior to take off and no preliminary tests were possible. Nevertheless, satisfactory contact was made immediately with the planes by central control and constant communication was had during the entire test period of 9:30 P.M. to 10:00 P.M. Reports of violations of the blackout order were made by observers in the planes via radio and immediately relayed to the control staff for action thereon. These planes operated at levels of 2500 to 3000 feet and 6000 feet, respectively. Satisfactory signal strength was noted at all times regardless of location of the planes, which traversed not only the Akron area but also Barberton, Cuyahoga Falls and other outlying districts. Upon conclusion of the blackout by central control radio reports were also received from several district control centers giving final reports of violations of the blackout. Col. Cochrun and the central control staff were very much impressed by the gratifying results accomplished.

It is believed that the WERS radio set-up in Akron will prove extremely valuable during emergencies such as air-raid blackouts and sabotage of Akron war industries. Of course, it is anticipated

(*Continued from page 118*)

that the Army Interceptor Command may order cessation of all radio transmission during the blackout. However, since it is apparent that the major need for communications will be subsequent to the departure of enemy raiding planes, WERS stations will then be available and will be especially useful, inasmuch as it is probable that the major portion of the telephone communication system will be out of order or partially destroyed as has been the experience in England.

Sometimes the argument is advanced that we are too far away to be bombed, but those who so contend are unable to overcome the argument of damage to these line systems from acts of sabotage or other contingencies such as floods. Since the establishment of the radio system for the Summit County Civilian Defense Corps, we are particularly fortunate in having a rapid and reliable means of communication to all parts of the warning area concerned. Our tests have shown that, even though the central control station, for example, may be destroyed or otherwise handicapped in operation, any designated district control center may take over its duties and maintain direct contact via radio with the other districts under our jurisdiction.

Profit by British Experience

We are attempting to profit by the experience of our British allies in that the British cities undergoing bombing raids or subject to acts of sabotage have found that their telephone communication and electrical power systems have been put out of commission, resulting in a serious delay in forwarding messages for police and fire assistance, as well as delay in supplying electrical power to homes, hospitals, factories and other establishments. In some localities it has been rather difficult to have the local OCD staff properly appreciate the likelihood of failure of the wire communication system, and they are inclined to place too great a dependence upon the telephone lines. Fortunately, this attitude has not prevailed in Akron to any objectional extent.

The radio aide and his co-workers should solicit the coöperation of city officials, such as the superintendents of the fire and police signal systems and members comprising the police and fire protective organization of the city, in connection with the installation of necessary lines or apparatus for the radio equipment. Naturally, it is essential that the commander and other members of the central control staff support and encourage the development of the radio facilities.

Acknowledgement is gratefully made by us for assistance rendered by our amateur co-workers and by the several city officials and members of their organization. We are especially grateful to Col. J. L. Cochrun, commander of the U. S. Civilian Defense Corps of Summit County, Ohio, and Mr. M. M. Konarski, county controller and commander of communications, for their assistance and encouragement in establishing and organizing the radio arrangement for the Summit County Civilian Defense Corps.

DECEMBER 1942

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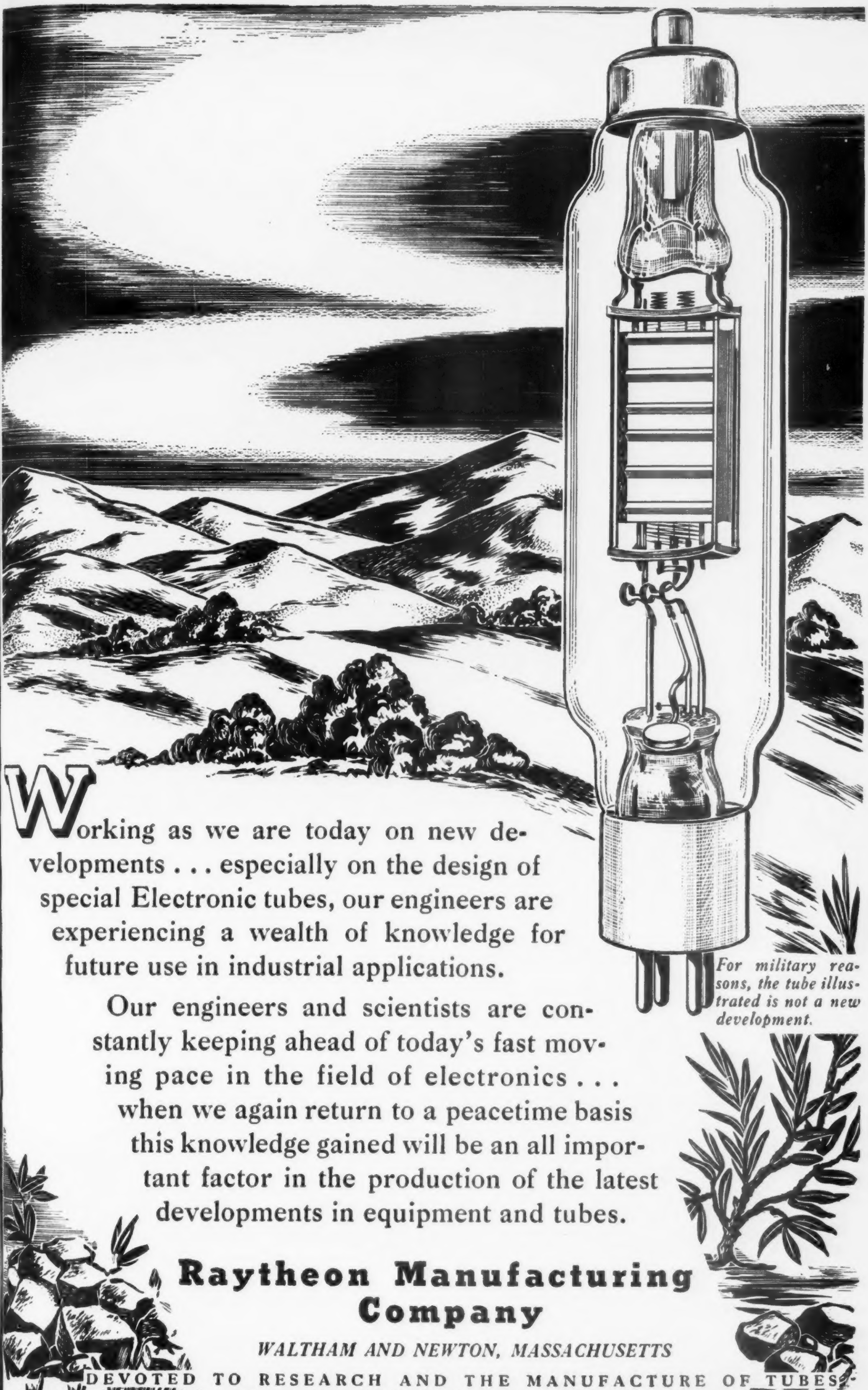
QST *devoted entirely to*

AMATEUR RADIO

PUBLISHED, MONTHLY, AS ITS OFFICIAL ORGAN, BY THE AMERICAN RADIO RELAY LEAGUE, INC., AT WEST HARTFORD, CONN., U. S. A.; OFFICIAL ORGAN OF THE INTERNATIONAL AMATEUR RADIO UNION

CONTENTS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Section Communications Managers of the A.R.R.L. Communications Department

Reports Invited. All amateurs, especially League members, are invited to report communications activities, training plans, code classes, theory-discussion groups, civilian-defense building or planning each mid-month (16th of the month for the last 30 days) direct to the SCM, the administrative official of ARRL elected by members in each Section whose address is given below. Radio Club reports and Emergency Coördinator reports representing community organized work and plans and progress are especially desired by SCMs for inclusion in *QST*. **ARRL Field Organization appointments**, with the exception of the Emergency Coördinator and Emergency Corps posts, are suspended for the present and no new appointments or cancellations, with the exception named, will be made. This is to permit full efforts of all in Emergency Corps plans.

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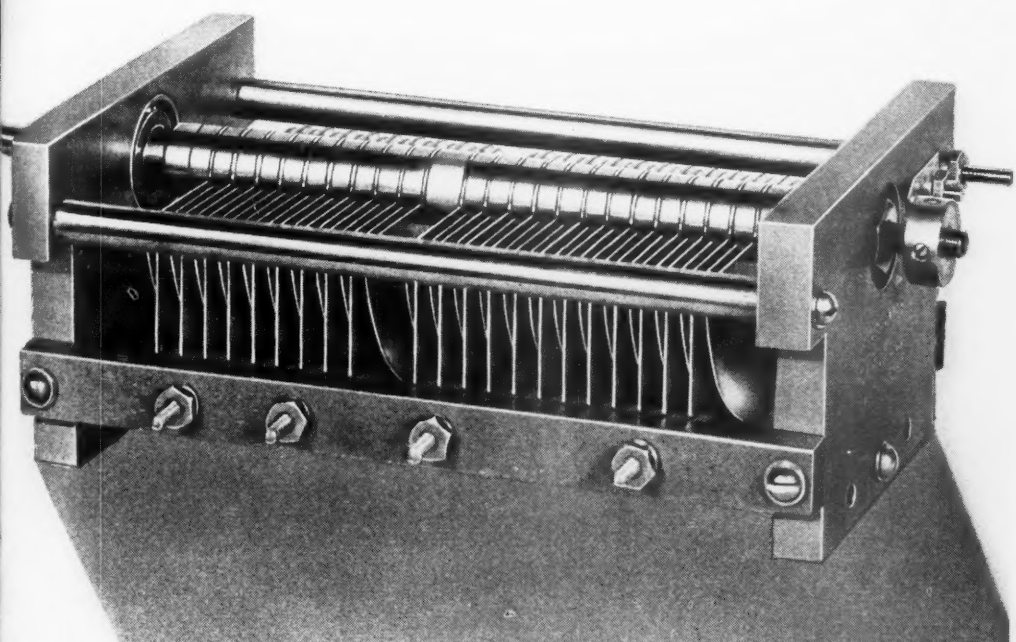

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It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is noncommercial and no one commercially engaged in the manufacture, sale or rental of radio apparatus is eligible to membership on its board.

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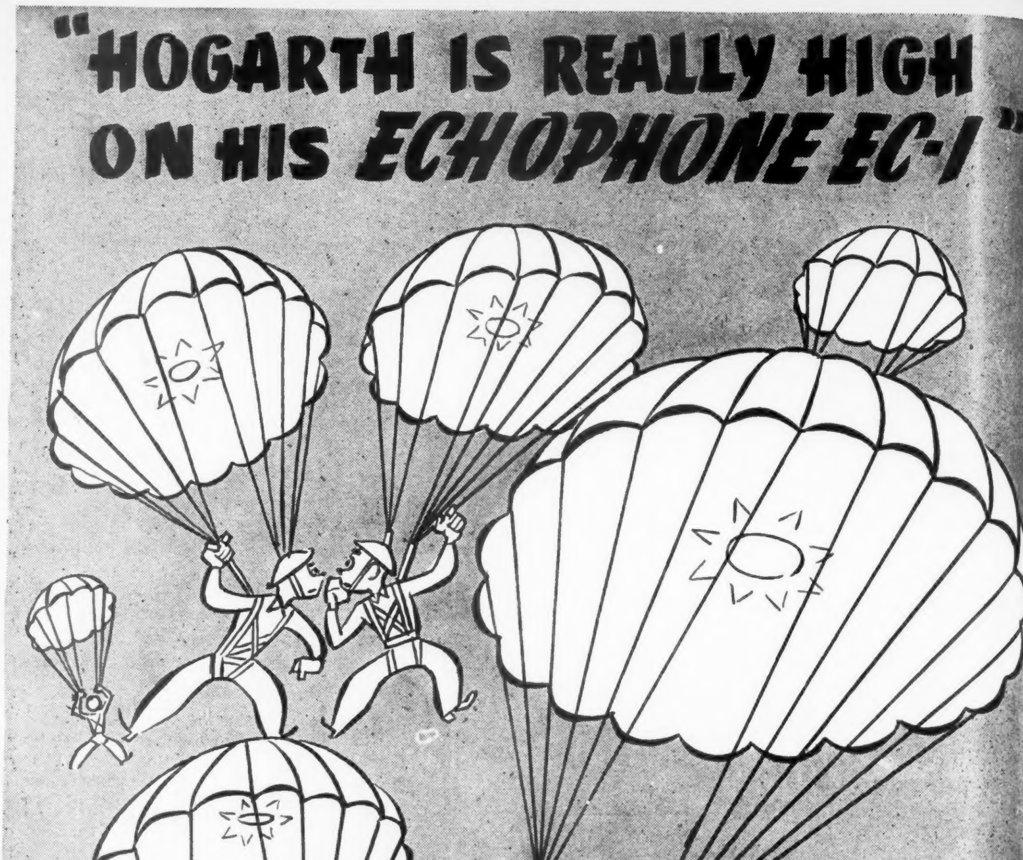
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